TANGANYIKA

Annual Report

of the

Department of Agriculture

1957

PART II

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PART II

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Frontispiece

Aerial View of Experimental Farm, Southern Region Research Centre, Nachingwea

TANGANYIKA

ANNUAL REPORT OF THE DEPARTMENT OF AGRICULTURE, 1957

Part II

GENERAL REVIEW

Introductory:

The reorganization of the research work of the Department on the basis of four Regional Research Centres, with supporting research stations and sub centres, is now almost completed. The Central Region Research Centre, at Ilonga, is the headquarters for research work in the Eastern and Southern Highlands Provinces. The new laboratory block has been completed, and the housing programme is well advanced. There are sub-stations at Wami, Mbozi, Chunya and Iringa. A semi autonomous station at Chambezi serves the coastal area.

At the Western Region Research Centre, Ukiriguru, the centre for the Lake and Western Provinces, plans have been drawn up for new laboratories and housing. Funds for a new water supply have also been made available. The Centre has sub-stations at Maruku, Mwanhala and Urambo. This last station has been taken over from the Tanganyika Agricultural Corporation, and will be used for research on tobacco and farming systems for the wetter "Miombo" areas.

The Research Centre for the Southern Province is at Nachingwea. Here new laboratories are nearly completed, and a fully developed farm has been taken over from the Tanganyika Agricultural Corporation. During the year an entomologist, plant breeder and chemist were seconded to the Tanganyika Agricultural Corporation.

The Central, Northern and Tanga Provinces are served by the Northern Region Research Centre at Tengeru, where new laboratories have now been erected.

Research programmes for these four Regions, which cover between them all parts of Tanganyika, are drawn up by the Regional Research Committees.

These committees usually include the specialist officers concerned, the senior officers in charge of extension work in the area, and a representative from Departmental headquarters in Dar es Salaam. Close liaison between the different Regional Centres, and with research work in other East African territories, is being maintained.

Research on food crops:

The research programme at the Central Region Research Centre, Ilonga, and elsewhere, is yielding results of some interest. Several trials investigating the effect of planting date on yield have been carried out, on maize, soya beans and groundnuts. Although rainfall was adequate and well distributed, even for the later plantings, yields from these were invariably greatly reduced. Examination of the results of a large number of experiments, both in the season under review and in previous years, has shown that this reduction in yield from late plantings appear to be a general phenomenon, even though growing conditions seem to be favourable. This problem clearly merits closer attention.

Results of the inter-cropping experiments at Ilonga and Mwanhala (a sub-station of the Western Regional Centre) are also of interest. It appears that in a year of good rainfall a greater economic return can sometimes be obtained from inter-cropping than with crops grown in pure stands. Furthermore, the labour input needed for the same economic return is generally less for inter-cropping.

At the Southern Regional Research Centre plant breeding and selection work with sesame is yielding useful results. Two non-shattering varieties from Venezuela show great promise. Venezuela 51, a single stemmed variety, may be suitable for mechanised harvesting. Venezuela 52, a multiple stemmed variety, appears suitable for distribution to African growers. No accurate yield estimates are yet to hand, as only a very limited quantity of seed was available. These Venezuelan varieties are being used in crosses with local sesame, and are also being bulked for possible direct issue, should their yield performance in trials prove satisfactory.

Also at Nachingwea, studies of bush fallowing on a number of soil types are in progress. This programme is partly a continuation of work carried out by the Tanganyika Agricultural Corporation. It is hoped to gain some understanding of the beneficial effects of bush fallowing on soil fertility, and if possible to work out a more suitable alternative method of maintaining fertility.

A plant breeding programme is being carried out at the Northern Regional Research Centre, Tengeru. It is hoped to produce a short-term maize variety, maturing in about eighty days, suitable for areas of Tanganyika where the growing period is limited by a short rainfall season. Work with wheat is also being carried out, in collaboration with the Kenya Department of Agriculture. The objective here is a rust resistant variety suitable for the Northern Province wheat growing area.

Cotton:

The new variety IL 58 gave an average increase in yield of 25 per cent, over the present variety, 47/10, at Ilonga, and on district plots in the Central Research Region. It is also slightly better in quality. It is now being bulked for issue to growers in this region.

At Ilonga the standard treatment recommended for bollworm control, 1 lb. of D.D.T. per acre per week, gave the highest yield and the greatest economic return. Alternative treatments using lesser quantities of dust gave valuable responses, but both yield and economic return were reduced.

At Ukiriguru, very substantial responses were again obtained from the application of cattle manure, nitrogen, and phosphate.

Coffee:

At Mbozi sub-station, (Central Research Region) an intensive study is being made of the serious die-back, sometimes referred to as "Black Tip", which commonly affects coffee in this area. It has been found that affected trees usually have very limited root development.

Stem-pitting of coffee has now been reported from all the principal *arabica* coffee areas of Tanganyika. Work at Lyamungu, recorded in this Report, is in progress to determine the cause of this condition. This research is being carried out in collaboration with the East African Agriculture and Forestry Research Organization.

Castor:

A large collection of castor varieties has been established at the Central Region Research Centre, Ilonga. A breeding programme has been started. The work of producing suitable varieties for various parts of the Territory will proceed along two main lines, one accepting the necessity for insect pest control by chemical means, the other incorporating resistance which appears to be present in the "wild", low yielding castor commonly found in the bush. Little is known regarding the behaviour of the newer dwarf or semi-dwarf types of castor, and a comprehensive agronomic programme has been planned.

A study of castor pests, at Tengeru, has been undertaken. The common *Lygus vosseleri* appears to be the most widely distributed castor pest, but several other insects have been shown to be serious pests of castor.

Cashew:

At Nachingwea studies are being made of the biology of *Helopeltis* species found on cashew. The information gained from these studies will provide a useful basis for drawing up spraying programmes. A wood boring weevil larva has been found damaging cashew and has been provisionally identified as *Mecocorynus loripes* Ches. This pest of cashew does not appear to have been previously recorded in Tanganyika. Trees damaged by the borer can be distinguished by the masses of black gum and frass which run down the trunk and accumulate on the ground below.

Pyrethrum:

A summary of the work carried out by the Department in collaboration with local farmers in the Uwemba area of the Southern Highlands Province is included in this Report. On the basis of this preliminary work a new research programme will be drawn up. It is clear that further research on what may be termed the "agricultural botany" of pyrethrum is necessary. Very little is known of the requirements of this crop as regards temperature, rainfall, management, etc.

REGIONAL RESEARCH STATION, ILONGA—GENERAL REPORT

METEOROLOGY

The season was characterised by exceptionally heavy and well distributed rainfall. This resulted in a very difficult harvest and yields of some crops were reduced by germination of the seed in the stooks. Whilst there was very little damage from soil erosion, both bulk crops and experiments suffered from flooding and standing water. Table I shows the distribution of the rainfall during the season.

TABLE I

Month	Rainfall in.	Number of days on which rain fell
November, 1956	0·88	4
December, 1956	9·74	12
January, 1957	6·21	10
February, 1957	4·68	12
March, 1957	8·32	17
April, 1957	11·13	24
May, 1957	9·96	15
Total	50·92	94

These figures represent the highest total rainfall and the highest rainfall for the month of May that have been recorded since readings were first taken in 1944.

AGRONOMY

Maize Detasselling Trial.—Maize was planted on 29th January, 1957, at three different spacings (6″ × 42″, 12″ × 42″ and 18″ × 42″). Table II shows the effects of the various treatments.

TABLE II

(Yields in lb./acre).

Spacing	42″ × 6″	42″ × 12″	42″ × 18″.	Mean
Tassels left:	2,557	2,196	1,877	2,210
Tassels removed:	2,702	1,999	1,544	2,082

Sign. Differences	Spacings	Detasseling treatment
P = 0·05	431	472
P = 0·01	598	642

There were no significant differences whether the tassels were removed or left at any population level.

There were, of course, highly significant differences between spacings.

Maize Variety Trial.—Four varieties of maize, Katumbili, Improved Katumbili (Ilonga strain), Eckstein, and Kalahari Early Pearl, were planted on the 9th of January and harvested after 104 days. Yields are shown in Table III.

TABLE III

Variety	Population (000/acre).	Yield (lb./acre).
Improved Katumbili	16·5	3,435
Kalahari Early Pearl	16·4	3,193
Katumbili	16·3	3,096
Eckstein	16·2	2,878
Sign. Differences		
P = 0·05	1·0	364
P = 0·01	1·5	552

The populations were very even and only Eckstein yielded significantly lower than Improved Katumbili. The Ilonga strain of Improved Katumbili used was produced by the Brieger method and the sample planted in the above experiment was a once grown synthetic.

Inter-relation of Maize Population and Rainfall.—This experiment was designed to find out if the effect of maize population on yield varies with the amount of rain falling during the growing period of the crop. Katumbili maize was planted at three different spacings and at three different dates. Table IV shows the results obtained.

TABLE IV

(Yields in lb./acre)

Spacing	11th Jan.	14th Feb.	1st March.	Mean
42″ × 6″	3,973 ...	905 ...	368 ...	1,749
42″ × 15″	3,219 ...	705 ...	279 ...	1,401
42″ × 24″	2,336 ...	539 ...	224 ...	1,033
Mean	3,176 ...	716 ...	290 ...	—

Sign. Differences	Body of table	Spacing means	Planting Date means
P = 0·05 ...	263 ...	151 ...	233
P = 0·01 ...	357 ...	206 ...	340

Differences in yields for the first planting were highly significantly in favour of close spacing, but not for the second and third plantings, although the 6 inch spacing in the 14th February planting yielded nearly two bags an acre more than the 24 inch spacing.

As was to be expected yields from the first planting were very much higher than those of the subsequent plantings.

Groundnut Time of Planting Trial.—Mwitunde groundnuts were planted at five different dates. Each planting was a separate experiment and three methods of planting were used, namely on the flat, on the ridge and on tie ridges. Table V shows the yields obtained.

TABLE. V

(Yields in lb./acre)

Treatments	3rd Jan.	21st Jan.	15th Feb.	4th Mar.	14th Mar.
Flat.	703 ...	484 ...	431 ...	192 ...	259
Ridged.	699 ...	607 ...	346 ...	205 ...	304
Tie Ridged.	637 ...	466 ...	394 ...	185 ...	226
Sign. Diff. P = ·05 ...	163 ...	132 ...	67 ...	73 ...	69
P = ·01 ...	233 ...	187 ...	85 ...	104 ...	97

Populations within each time of planting were fairly even and differences between treatments were seldom significant. The earlier plantings gave the greatest yields.

Groundnut Variety Trial.—Five varieties of groundnuts were planted on January 8th. The varieties were Natal Common, Mwitunde, Mwitunde (strain 2), Kanyoma and Chunya (a variety from the Southern Highlands Province).

Natal Common was harvested after 107 days and the remaining varieties after 119 days. The results of this trial are presented in Table VI.

TABLE VI

Varieties	Population (1000 plants/acre)	Yield (lb./acre)	Shelling percentage
Natal Common ...	40·2 ...	1,397 ...	54·4
Mwitunde (strain 2) ...	40·0 ...	1,256 ...	52·0
Mwitunde	41·4 ...	1,084 ...	47·0
Kanyoma	40·0 ...	1,040 ...	57·6
Chunya	24·5 ...	951 ...	50·0
Sign. Diff. P = ·05 ...	2·6 ...	296 ...	8·6
P = ·01 ...	3·7 ...	415 ...	12·1

Chunya gave only 70 per cent germination when it was tested, which may account for this variety giving a significantly lower yield than the first two varieties.

Rainfall Conservation Experiment—Groundnuts.—This trial was designed to see whether it was possible to conserve rainfall by clean cultivation of land even though planting was considerably delayed. It was thought that under clean conditions the soil might be able to absorb and retain rain better than would be the case under a weed fallow. Mwitunde groundnuts were used as a test crop and the treatments were as follows:—

A—ploughed on 2nd January and the land kept clean until it was planted on March 4th.

B—ploughed and planted on January 2nd.

C—ploughed on February 4th and the land kept clean until it was planted on March 4th.

D—ploughed and planted on February 4th.

E—ploughed and planted on March 4th.

Table VII shows the results obtained.

TABLE VII

(Yields in lb./acre. Population 000/acre)

Treatments	Population	Yield	Gleanings	Shelling percentage
A	36·8 ...	117 ...	57 ...	59·0
B	50·6 ...	696 ...	92 ...	47·5
C	38·2 ...	121 ...	65 ...	63·0
D	43·5 ...	260 ...	90 ...	48·0
E	32·2 ...	60 ...	36 ...	60·0
Sign. Diff. P = ·05 ...	4·9 ...	155		
P = ·01 ...	6·6	212		

The differences in yields and populations were highly significant, only treatment B giving a reasonable yield and a good population. Probably the chief reason for the difference in population levels was the poor seed bed conditions which arose from ploughing in long grass and planting on the same day. Even those plots which were ploughed early in the season and kept clean by discing gave a very poor seed bed, as they became very compacted by the cultivations required to keep them clean. The low population levels may have accounted to some extent for the low yields of the later planted treatments, but it is thought that the main loss was more probably a time of planting effect.

Effect of Phosphate and Molybdenum on the Yield of Soya Beans.—A factorial experiment was carried out with variety Hernon 237, testing molybdenum, phosphate, and inoculum. Molybdenum was applied at 12 oz. to the acre, and phosphate at 75 lb. of double superphosphate per acre. Inoculum was applied as recommended by the producers. The principal results are given in Table VIII.

TABLE VIII

(Yields in lb./acre. Population in 000/acre)

Treatments	Yield	Population
NIL	468 ...	42·6
Molybdenum ...	519 ...	40·1
Inoculum	544 ...	40·5
Phosphate	403 ...	40·1
Phosphate & Molybdenum	451 ...	34·1
Phosphate & Inoculum	563 ...	26·8
Molybdenum & Inoculum	538 ...	44·2
Phosphate & Molybdenum & Inoculum	551 ...	39·1
Sign. Diff. P = ·05	163 ...	9·4
P = ·01	220 ...	12·7

Main effects

Inoculum	+88		
Phosphate	—25	Sign. Diff. P = 0·05 ...	82
Molybdenum	+20	P = 0·01 ...	110

There were no significant yield differences between individual treatments but the main effect of inoculum was just significant at the 5 per cent level. Interactions were not significant. All yields were very low.

Soya Bean Time of Planting Experiment.—Soya bean variety Hernon 237 was planted at five different times. The results are shown in Table IX.

TABLE IX

(Yield in lb. Per Acre)

Date of Planting		Yield	Population
February 5th		746 ...	46·6
February 28th		449 ...	31·8
March 12th		556 ...	49·2
March 26th		387 ...	52·1
April 9th		186 ...	27·7
Sign. Diff. ...	P = ·05	122	
	P = ·01	166	

There was considerable variation in population levels due mainly to adverse planting conditions on February 28th and April 9th.

Intercropping Trial—Maize and Groundnuts.—A factorial trial was carried out with maize and groundnuts grown in pure stands and intercropped in all combinations of the following plant populations per acre:—

Maize	12,000 ...	8,000 ...	4,000 ...	nil Plants/acre
Groundnuts	40,000 ...	30,000 ...	20,000 ...	nil Plants/acre

The effects of interplanted groundnuts on maize yield are shown in Table X.

TABLE X

Effect of groundnut population on maize yield

Groundnut population, plants/acre	40,000	...	30,000	...	20,000	...	Nil
Mean maize yield, lb./acre ...	2,225	...	2,187	...	2,227	...	2,439
			Sign. Diff. P = 0·05			168	lb./acre
			P = 0·01			228	lb./acre

Maize yields were only slightly reduced by the presence of interplanted groundnuts although the reduction in yield was significant at all the groundnut populations tested.

The effects of interplanted maize on groundnut yields are shown in Table XI.

TABLE XI

Effect of maize population on groundnut yield

Maize population, plants/acre ...	12,000	...	8,000	...	4,000	...	Nil
Mean groundnut yield, lb./acre ...	229	...	333	...	466	...	794
			Sign. Diff. P = 0·05		...	66	lb./acre
			P = 0·01		...	87	lb./acre

Groundnut yields in the interplanted plots were very significantly less than where the crop was grown in pure stand.

As might perhaps be expected, the effect of maize population on maize yield was highly significant, but at the population levels tested, groundnut yield was not significantly affected by groundnut populations.

These results raise some interesting questions regarding the economics of pure stand cropping, and the intercropping commonly practised by African cultivators. The correct comparison is the yield of half an acre of each of the crops in pure stand with the produce of an acre of mixed crops. Such a comparison is given in Table XII.

TABLE XII

Yields of pure stands (¼ acre) of maize and groundnuts, yields from 1 acre of mixed crops, and gain or loss in yield resulting from intercropping

Population		Pure stand yields (¼ acre) (lb.)		Intercropped yields (1 acre) (lb.)		(+) (—) Net gain or loss (lb.)	
Maize	Groundnuts	Maize	Groundnuts	Maize	Groundnuts	Maize	Groundnuts
12,000	40,000	1,482	407	2,546	280	+1,064	—127
12,000	30,000	1,482	370	2,699	195	+1,217	—175
12,000	20,000	1,482	415	2,822	215	+1,340	—200
8,000	40,000	1,312	407	2,330	346	+1,018	—61
8,000	30,000	1,312	370	2,140	372	+828	+2
8,000	20,000	1,312	415	2,177	281	+865	—134
4,000	40,000	867	407	1,804	546	+937	+139
4,000	30,000	867	370	1,732	437	+865	+67
4,000	20,000	867	415	1,687	416	+820	+1

At present market values, it would appear that under the experimental conditions, all the combinations of maize and groundnut populations tested gave a higher economic return per acre than either maize or groundnuts in pure stand.

Cultivation Trial.—This trial was designed to find the cheapest method of primary cultivation consistent with good yields and sound land usage. It is not capable of being analysed statistically. The methods of primary cultivation used were as follows:—

A — single discing (Baronet).
B — ripping followed by single discing (Baronet).
C — ridge busting only.
D — Goble discing only.
E — ridge busting plus ripping.
F — deep ploughing followed by light discing.
G — one way disc harrowing.

Fairly large plots (50 yards × 100 yards) were used and these were split for two crops, maize and groundnuts. The crops were planted on 2nd and 3rd of January. On the 11th of February all treatments were mechanically weeded between the rows, and hand weeded in the rows. By the 8th March it was obvious that treatments A, B and C would require a further weeding before they were harvested but all the other treatments could have gone through to harvest without this final weeding.

Table XIII shows the yields of maize and groundnuts taken from random plots in each treatment.

TABLE XIII

Maize			Groundnuts				
Treatment	Population /000 plants /acre	Yield lb./acre	Treatment	Population /000 plants /acre	Total yield lb./acre	Gleaning lb./acre	Shelling percentage
A	17·7	2,323	A	44·6	1,120	81	54·0
B	18·3	2,251	B	45·3	1,193	123	57·0
C	19·3	2,312	C	45·4	1,307	106	57·0
D	18·3	2,624	D	43·5	1,307	81	56·0
E	19·4	2,728	E	45·3	1,442	106	60·0
F	18·2	2,831	F	45·6	1,483	199	64·0
G	20·2	2,645	G	48·3	1,421	222	63·0

Although it is not possible to say whether any of the differences are significant it is interesting to note that the same four treatments gave the highest yields for both crops and the highest shelling percentages for groundnuts.

F. M. Spencer,
Agricultural Officer

WAMI SUB-STATION

Meteorology

Table I shows rainfall during the 1956/57 season.

TABLE I

Month	Rainfall (inches)	No. of days on which rain fell
December, 1956	1·87 ...	6
January, 1957	5·90 ...	12
February, 1957	2·50 ...	8
March, 1957	6·02 ...	10
April, 1957	17·41 ...	24
May, 1957	3·78 ...	18
	37·48 ...	78

Between February 8th and March 16th only 0·90″ of rain fell. This dry spell caused serious reduction in yields in some plantings. On April 7th the land was badly flooded after 4″ rain which fell in one storm. Waterlogged conditions persisted for nearly three weeks and led to further reduction in yield. In all it was a very difficult year for the sub-station.

Maize Fertilizer Trial.

A 2 × 2 × 2 N.P.K. factorial experiment was carried out. The trial was planted on January 31st, conditions being very wet. Fertilisers were applied at the following rates:

Nil and 125 lb. of double superphosphate per acre.
Nil and 125 lb. of muriate of potash per acre.
Nil and 200 lb. of sulphate of ammonia per acre.

Phosphate and potash were applied in the seed bed and the nitrogen was added as a top dressing on the 28th of February.

The principal results are presented in Table II.

TABLE II

Fertiliser	Yield (lb./acre)	Population (000/acre)
NIL	1,608 ...	25·4
N	2,112 ...	27·2
P	1,631 ...	28·7
K	1,682 ...	27·3
NP	2,182 ...	26·7
NK	1,973 ...	26·8
PK	1,671 ...	26·2
NPK	2,018 ...	26·0
Sign. Diff. P=·05	480 ...	2·0
P=·01	645 ...	2·7

Main Effects	Sign. Diff.	
N = +373	P = ·05 ...	240
P = +83	P = ·01 ...	322
K = —97		

Sulphate of ammonia gave useful increases in yield. Interactions were not significant.

Maize Time of Planting Trial.

Katumbili maize was planted at five different dates (see Table III).

TABLE III

Date of Planting	Yield (lb./acre)	Population (000/acre)
18th January ...	1,534 ...	14·8
31st January ...	2,175 ...	14·6
12th February ...	1,623 ...	13·0
4th March	713 ...	12·8
19th March	434 ...	12·9
Sign. Diff. P = ·05	589 ...	2·0
P = ·01	803 ...	2·7

These results and those which follow (Tables IV and V) emphasise the necessity of early planting.

Groundnut Time of Planting Trials.

(a) Mwitunde groundnuts were planted at five different dates (see Table IV) in 42″ rows with 3″ between the plants in the rows.

TABLE IV

Date of Planting	Yield (lb./acre)	Population (000/acre)
Planted 18th January	892 ...	30·7
Planted 31st January	837 ...	30·6
Planted 12th February	395 ...	24·5
Planted 4th March ...	278 ...	30·7
Planted 18th March ...	183 ...	35·5
Sign. Diff. P = ·05	291 ...	9·7
P = ·01	396 ...	13·1

(b) Natal Common groundnuts were planted at the same spacing and on the same dates as the variety Mwitunde above. See Table V.

TABLE V

Date of Planting	Yield (lb./acre)	Population (000/acre)
Planted 18th January	657 ...	27·4
Planted 31st January	1,065 ...	31·9
Planted 12th February	647 ...	23·9
Planted 4th March ...	278 ...	31·3
Planted 18th March,...	205 ...	35·5
Sign. Diff. P = ·05	153 ...	7·2
P = ·01	209 ...	9·9

F. M. SPENCER,
Agricultural Officer

REGIONAL RESEARCH CENTRE, ILONGA

Plant Breeding: Castor

Introduction.

This work began in February, 1957, with seed available from 46 varieties of castor from North America, Asia Minor, Europe and Africa. Since that date many more varieties have been obtained, chiefly from America, India and South Africa.

There are two main objectives. More immediately, short-term varieties which have high yields are required for the peasant cultivator. These varieties should be non-shattering, of medium height, resistant to insect attack, and have a reasonably high oil percentage in the seed. This is in preference to the many giant forms now grown which often have very poor yields, shatter considerably and are susceptible to insect damage. A second objective is the breeding of short-term dwarf castors, also possessing a high yield, good oil content, non-shattering fruits and insect tolerance, suitable for mechanised harvesting. Varieties of this type would be grown on African tenant schemes.

Breeding Programme.

Castor is wind pollinated and generally monoecious. There is considerable outbreeding although estimates of the extent vary from 5–36 per cent. The maintenance of inbred varieties therefore requires some care and isolation of at least 300 yards is necessary to prevent cross-pollination. The species is extremely polymorphic and heterozygous for most characters, providing a wealth of genetic material for selection.

The varieties of castor at Ilonga may be conveniently classified as follows:—

(i) Indigenous long-term giant forms often possessing a high degree of resistance to insect attack, large seeded but usually shattering.

(ii) Introduced medium-term types of medium stature, possessing variable resistance to insect attack, fairly high yielding but often shattering.

(iii) Introduced short-term dwarfs with variable but usually poor resistance to insect attack, small seeded, potentially high yielding, and usually not shattering.

From the above it can be seen that the ideal plants for our requirements are not immediately available for selection. There are however within each group certain varieties which approximate to the ideal and it is from these that selection is being made. In addition hybridisation of promising types is being used in an attempt to combine desirable characters.

Two varieties, Cimarron Inbred and ME both in group (iii) possess under some conditions a certain tolerance to insect attack and have yielded well at Ilonga. These semi-dwarf types are 5–6 ft. tall and have non-shattering seeds. Within ME attempts are being made to select dwarf or semi-dwarf types with high yield. Attempts are also being made to increase oil content by selection. With most other varieties the quantity of seed available and the high incidence of insect damage have as yet made it impossible to assess their true performance.

The most striking observation from this season's work has been the damage caused to the young inflorescences and fruits by insect attack. The insects responsible at Ilonga are mainly members of the *Capsidae* (*Miridae*), which attack the young inflorescence and prevent further development. In addition some *Pentatomidae*, in particular a green shield bug *Nezara viridula*, cause a precocious fall of young fruits by damaging the young seeds developing within. Populations of capsids at Ilonga build up slowly from the middle of April and reach a maximum in July but at the end of August they suddenly disappear. After this latter date, even though it is late in the season, susceptible varieties often bear good yields.

Rattooned castor (cut back in November and fruiting in January) has so far this season shown no evidence of capsid damage. But another pest, the elegant grasshopper (*Zonocerous elegans*) ravages the vegetative parts of the plant during the early rains and at Ilonga plants rattooned in November develop only very slowly unless control measures are taken. The grasshopper usually disappears about the beginning of January.

The differential response of the various varieties to capsid and *Nezara* damage is well illustrated by comparing the yields from bagged and unbagged heads. When an inflorescence is covered with a cotton bag impregnated with 1 per cent DDT insect damage is prevented. Whilst the full potential of the variety may not be realized under such conditions, since there is evidence that bagging itself depresses yield, the difference in yield between bagged and unbagged heads is a rough measure of the susceptibility of a particular variety to insect damage. Fig. I shows the average number of fruits per inflorescence for bagged and unbagged heads. The overall increase in yield (fruits per inflorescence) of bagged over unbagged inflorescences is 170 per cent. It is particularly interesting to note that the percentage yield increase in introduced varieties was 280 per cent, whereas in indigenous types it was only 120 per cent. This observation appears to confirm previous observations that indigenous types have a much greater resistance than introduced forms. A few varieties, particularly C73 (See Fig. I), having a more or less complete tolerance to capsids, show a higher yield without bags than with them.

Castor Yields at Ilonga.

Little data is available on the performance of castor in the Territory. The yields presented in Table I are from small unreplicated plots, but give some indication of the yield potential of two varieties. Although the plots were not dusted with insecticide, very little insect damage occurred.

TABLE I

Variety	Origin	Plot size	Yield (lb./acre)	Date of planting
Cimarron Inbred...	U.S.A.	1/300	3,000	End February
Cimarron Inbred...	U.S.A.	1/600	2,000	End March
ME	Israel	1/120	1,600	End February
ME	Israel	1/170	1,500	End March

Yields from small plots, without replication are unreliable, and should be treated with reserve. In other trials Cimarron Inbred has been seriously damaged by insect pests and has yielded poorly. The variety would however seem to be potentially very promising, if only as a parent in a breeding programme.

With both these varieties, early planting (at the end of February) gave the higher yield. Further trials on the effect of date of planting will be carried out in 1958.

Seed Oil content.

At the end of the 1956 season seed from 46 castor varieties was analysed for oil content. Further samples from the same varieties have also been tested this year. A comparison of the two sets of data, has been made and no correlation is evident between the 1956 and 1957 oil content figures. This result suggests either that the oil content of a variety is largely determined in any one season by the environmental conditions or that, with the "varieties" tested, genetic segregation for oil content is taking place. Further investigation of this problem will be carried out.

The following additional observations were made from castor samples sent for analysis.

(i) Seed of "Italian" harvested when the spiny pericarp was still green (but the seed apparently mature) had 20 per cent less oil than samples from the same plant harvested when the pericarp was brown (Table II).

This difference probably is largely due to the incomplete development of the endosperm in the immature fruits, a condition not manifested in the outer appearance of seed. Since the majority of African peasants harvest their castor (which normally shatters badly) before the seed is completely ripe, it is quite possible that a maximum oil content is not always obtained.

(ii) A comparison of bagged selfed and unbagged crossed seed from the same plant indicates that the selfed seed has a lower oil content (Table III). Whether this is a real difference due to selfing or merely an effect due to the presence of a bag over the inflorescence is not certain. Probably it reflects a real difference since the bag only covers the young inflorescence for a relatively short period of time.

FIGURE I

A comparison of yields bagged and un-bagged loads of introduced and indigenous varieties of castor. Each column of the histogram represents a separate variety.

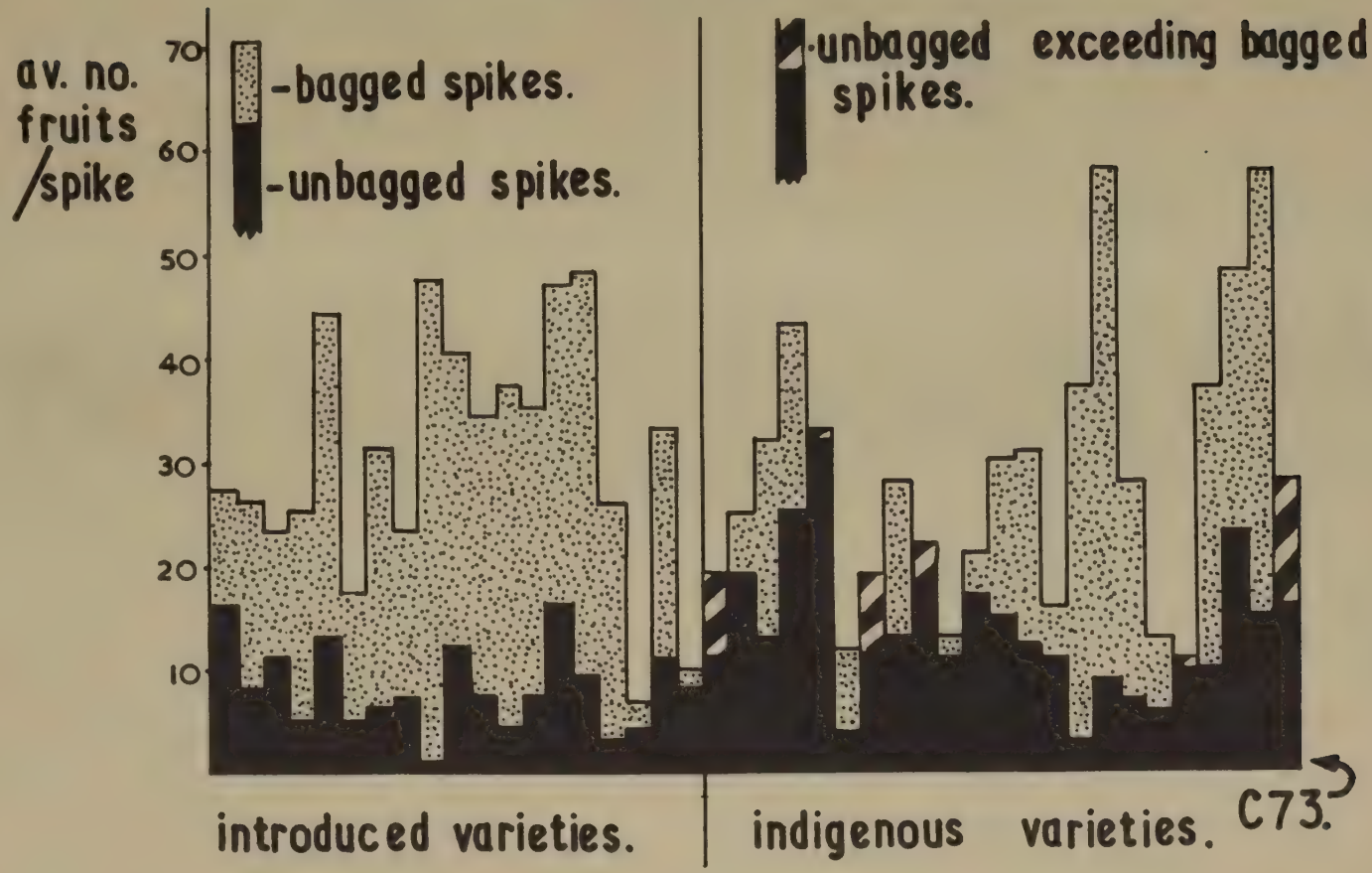

TABLE II

RIPENESS TEST

	Plant	Sample	Oil percentage	Average
Italian	A ...	1 ...	48·6	
	A ...	2 ...	49·0 ...	46·3
	B ...	1 ...	47·5	
	B ...	2 ...	39·9	
		Sample (Ripe)		
	A ...	1 ...	55·7	
	A ...	2 ...	58·6 ...	57·1
	B ...	1 ...	57·2	
	B ...	2 ...	56·9	

TABLE III

CROSS/SELF TEST

	Plant	Oil Percentage Crossed	Selfed (with bag)
Italian	1 ...	55·5 ...	54·1
	2 ...	58·5 ...	47·5
	3 ...	56·5 ...	55·0
	4 ...	57·2 ...	53·9
	5 ...	57·1 ...	53·2

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Cotton Cultivation Trials and Cotton Breeding

Cotton Cultivation Trials:

Ilonga and District Plots.—The heavy rain of March, April and May affected trials. Insecticide application was difficult for operators due to wet soil conditions, and the constant rain probably washed some insecticide off the plants. 10 per cent DDT and 3 per cent BHC dust was used on all trials. Standing water and flooding occurred periodically at most sites of experiments, but high yields were obtained where conditions were not too extreme.

Ilonga.—Within a series of demonstration plots sown at various dates, February planted dusted cotton gave the highest yield. The two spacing trials, one planted in February, the other in March, gave a similar result (Table I). Yields were higher in the closer spacings at both dates of planting, but the differences obtained were not statistically significant.

TABLE I

Yields in lb./acre seed cotton

Planted			February	March
Treatment.				
3 ft. between rows, 1 ft. between plants, ...	1 plant/hole	...	1,607 ...	401
3 ft. between rows, 1½ ft. between plants, ...	2 plants/hole	...	1,567 ...	402
3 ft. between rows, 3 ft. between plants, ...	2 plants/hole	...	1,510 ...	334
		Sign. Diff.	N. S.	N.S.
		C. of V.	10%	36%

The March planting gave considerably lower yields than the February planting partly due to attacks by Pink bollworm and stainers in August, September and October before the bolls had opened. Picking of the February planting had finished by 6th August.

District plots.—Date of planting, dusting and spacing treatments were investigated. The yields obtained for the pertinent treatments at each site are shown in Table II.

TABLE II

Yields in lb./acre seed cotton. Mean values for all spacings

Site	Handeni	Miono	Mwaya	Kissaki	Mikese
Planted February:	23·2·57	27·2·57	22·2·57	8·2·57	4·2·57
March:	1·3·57	6·4·57	29·3·57	20·3·57	27·2·57
Treatments:					
February planted, dusted:	260	654	663	1,967	2,064
February planted, not dusted:	Nil	360	449	1,338	1,442
March planted, dusted:	237	408	470	1,134	985
March planted, not dusted:	Nil	110	321	1,059	302
Sign. Diff. (P = ·05)	NS	254	NS	402	346

In all trials at all places both insecticide use and February planting gave higher yields.

The results for the spacing treatments were confusing and varied from place to place. The general trend however is reflected in the mean yields for all sites, shown in Table III. No treatment was significantly the best but generally closer spacing gave the higher yields. Three feet between rows and one foot between plants, thinned to one plant per hole, still appears to be the best general recommendation for all areas.

TABLE III

Mean yields in lb./acre seed cotton for all sites

DETAILS AS FOR TABLE II

	Dusted	Not dusted
February Planted:		
3 ft. between rows, 6″ between plants, 1 plant/hole ...	1,121	735
3 ft. between rows, 12″ between plants, 1 plant/hole ...	1,289	696
3 ft. between rows, 18″ between plants, 2 plant/hole ...	1,039	772
3 ft. between rows, 36″ between plants, 2 plant/hole ...	1,040	670
March Planted:		
3 ft. between rows, 6″ between plants, 1 plant/hole ...	632	423
3 ft. between rows, 12″ between plants, 1 plant/hole ...	751	456
3 ft. between rows, 18″ between plants, 2 plant/hole ...	634	399
3 ft. between rows, 36″ between plants, 2 plant/hole ...	573	317

Rain grown types.—The present selected material has been obtained from genetically variable local stocks. The aims of the selection programme are good jassid resistance, high yield and good ginning outturn with the present high lint quality. Assessment of selected material has continued at Ilonga. Once a relatively stable population with a high gene frequency for the desired characters has been established it is proposed to continue selection using the progeny row selective index technique. It is desirable under local conditions to keep trials small to ensure that insecticide is applied properly to all plots; for this the selective index is useful.

IL. 58, a multi-line issue, is to be multiplied at Chabe by the Department of Agriculture in the coming season. It will eventually replace 47/10. IL. 58 has given an average increase in yield of 25 per cent over 47/10 at Ilonga and on district plots this season. The average increase in ginning outturn has been 2 per cent. Results of spinning tests at the Shirley Institute are shown in Table V.

TABLE V

	Effective length (mm)	Stelometer strength reading	Maturity ratio	Standard fibre Wt.	Correct lea count × strength product	Yarn Appce. 1=V. good 7=V. poor
Ilonga						
IL. 58 ...	40	19·5	0·845	174	2,104	3
47/10 ...	41	19·5	0·765	175	2,098	3
Wami:						
IL. 58 ...	40	20·3	0·845	185	2,064	3
47/10 ...	40	18·6	0·775	191	1,984	4

IL. 58 consists of seven strains from two original parent types. All have given consistently higher yield than 47/10. None are jassid resistant but all are more jassid tolerant than 47/10. The plant habit tends to be tall, a bad character where insecticide use is necessary. However, where growing conditions are very good it seems doubtful whether a small compact type of plant will be capable of fully exploiting the yield potential of the area.

Main Variety Trial.—The results of the main variety trials at Ilonga and on district plots are presented in Table VI. Nine strains were compared in a 3 × 3 balanced lattice using 4 replications at each site. Insecticide dust was used on all trials.

The 54 selections showed more resistance to jassid than 47/10, IL. 58 or the 53 selections. They also gave higher ginning percentages and lint indices. The biggest yield differences were at Ilonga where all strains tested yielded from 64 per cent to 91 per cent more than 47/10.

Rain grown Types Trial.—A trial to test 100 strains was planted at Ilonga in a triple lattice design with six replications. The remaining 54 and 55 selections were tested against the original parent types, 47/10 and local.

Mean values of yield, lint length, ginning outturn, and lint index for the strains selected for further trial are shown in Table VII.

TABLE VI.—MAIN VARIETY TRIAL

Site	Ilonga			Mikese			Kissaki			Miono			Mwaya			Handeni		
Date Planted	31.1.57			4.2.57			20.3.57			27.2.57			22.2.57			12.3.57		
Strains	Lint lb./ac.	G.O.T.	L.I.	Lint lb./ac.	G.O.T.	L.I.	Lint lb./ac.	G.O.T.	L.I.	Lint lb./ac.	G.O.T.	L.I.	Lint lb./ac.	G.O.T.	L.I.	Lint lb./ac.	G.O.T.	L.I.
IL. 58	755	29·3	3·7	908	31·3	4·3	367	30·8	4·1	244	30·8	4·0	229	30·8	3·9	548	32·5	4·6
47/10	414	27·5	3·6	880	29·5	3·7	280	29·5	3·9	221	30·0	3·7	196	28·8	3·4	503	30·7	4·4
53/128	700	28·8	3·8	913	31·0	4·2	434	30·8	4·1	203	31·7	4·1	260	31·5	4·2	489	32·5	4·8
53/122	677	27·8	3·7	894	30·0	4·1	386	29·5	3·8	245	30·7	3·8	236	31·0	3·8	(U.K. 51) 601	33·3	4·9
53/193	728	27·5	3·7	812	30·7	4·0	378	30·0	4·1	212	30·0	3·7	212	29·0	3·6	471	31·3	4·8
54/275	791	30·5	3·9	969	32·5	4·2	383	30·5	4·3	273	31·3	4·5	217	30·5	4·1	597	32·3	4·9
54/298	736	31·5	3·8	922	32·3	3·9	368	29·3	4·8	214	31·5	3·8	234	31·8	3·9	631	33·0	4·6
54/155	729	31·8	4·6	865	32·0	4·7	378	30·5	4·7	235	32·0	4·4	257	32·5	4·2	594	32·0	4·9
54/55	698	31·0	4·3	791	30·0	4·2	362	31·0	4·3	205	30·0	4·0	260	31·0	4·2	460	31·5	4·7
Sign. Diff. (P=·05)...	123			N.S.			80			N.S.			N.S.			N.S.		
C. of V.	24%			11%			15%			14%			22%			16%		

TABLE VII

Group	Yield seed cotton lb./acre	Mean lint length in mm's	G.O.T.	Lint Index
54	1,648	36·7	30·5	4·2—23 strains
55	1,413	36·5	30·7	4·3—23 strains
Parent types	1,405	36·6	29·6	3·9
Local	862	37·1	30·0	4·1
47/10	970	37·0	28·8	3·6

56 Selections.—216 of the 56 selections were planted and of these 80 will be grown in a variety trial next year on Ilonga. Strains were discarded on poor habit and jassid susceptibility.

General.—Ginning percentages this season were higher than in the previous year. Samples of 47/10 ginned between 28 per cent and 30 per cent as compared with 25 per cent last year. Lint indices also were higher; 47/10 giving 3·6 compared with 3·2 in 1956.

Jassid infestation was high and the later selected material has a relatively high level of resistance.

Irrigated Types—Ilonga.—A trial of possible irrigated types was grown at Ilonga under rainfall conditions. The poorest yields were obtained from imported long staple varieties from the Sudan. The lax habit and slow fruiting of these strains made control with insecticide difficult. None have any jassid resistance and several strains suffered severely from jassid attack early in the season. The varieties with no blackarm resistance suffered heavily from this disease.

The Uganda and Lake Province types yielded well, their jassid resistance being a distinct advantage. However, they tended to be more leafy and fruit more slowly than the Ilonga selections and their final yields were lower than those of the Ilonga types.

Control of insects by "cotton dust" was not good. Average yields of the various groups are shown in Table VIII.

TABLE VIII

Group	No. of Strains	Yields lb./acre seed cotton
Sudan types	5	145
Uganda	5	572
Lake Province	2	407
Ilonga	20	676
Control—local rain grown types ...	4	761

Selections.—Within the Ilonga "finer lint" strains 110 selections were made and 66 will be planted in the coming season. Selections were made on the basis of jassid resistance and high lint index combined with fine lint characters.

Irrigation types—Lumemo.—At Lumemo, the Tanganyika Agricultural Corporation trial irrigation farm in the Kilombero Valley, nine varieties were planted in observation plots during February and grown mainly under rainfall conditions. Flooding occurred periodically and insecticide application was difficult. The results obtained are shown in Table IX and are similar to those obtained at Ilonga.

TABLE IX

Results of "finer lint" varieties planted in observation plots at Lumemo Trial Farm

Place of origin	Variety	lb./acre seed cotton	G.O.T.	Mean Lint length in mm's (20 combed seed)
Sudan	BL. R. 14/25 ...	530 ...	34·5 ...	40·7
	Domain Sakel ...	363 ...	37·0 ...	40·4
	BAR 173OL ...	447 ...	41·5 ...	39·3
	Wilds 16/1	335 ...	34·0 ...	37·4
Uganda	L3/42	670 ...	34·0 ...	36·3
	C(53) 16	530 ...	35·0 ...	37·3
Lake Province ...	0/457	921 ...	33·0 ...	35·5
Ilonga	R. 90	977 ...	31·0 ...	38·1
	R. 157	921 ...	31·5 ...	38·5

The indications are that selection within the finer lint types of local stocks will provide the best adapted varieties for any large scale irrigation project in the Rufiji Basin area.

Time of Planting Trial, Lumemo.—Plots were also planted monthly, February to June, to find the optimum planting date at Lumemo. The February planting gave the higher yield. The results are shown in Table X. Variety 47/10 was used in this trial.

The cotton was mainly grown on rainfall. Where irrigation was used the soil capped and the water had difficulty in penetrating through the surface.

TABLE X

Yields of Time of Planting plots Lumemo Trial Farm

Variety 47/10. Yield in lb./acre seed cotton

	Insecticide	No Insecticide
February planted ...	947	452
March ,, ...	387	242
April ,, ...	210	108
May ,, ...	167	70

The use of insecticide appears to be essential for high yields. The main pests were American bollworm, Spiny bollworm and Stainers.

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Cotton Entomology

Insecticide Trials.

The standard insecticide application recommended to growers is 1 lb of D.D.T. per acre per week, over a period of two months, with the inclusion of $\frac{1}{4}$ lb B.H.C. as an aphicide when required. The object of the work recorded here was to find methods of reducing the total amount, and hence the cost, of insecticide used, without any considerable increase in insect damage.

Trial No. 1.

As the greatest amount of crop loss due to American bollworm takes place during the period of formation of buds and small bolls it was considered that if adequate protection was given during the first month—up to the peak of flowering—the rate of application could be reduced during the second month. Alternatively the rate could be reduced in each second week to a level just sufficient to prevent the pest population from increasing above that of the previous week.

TABLE XI

Treatment	lb. DDT per acre per application 1st Month	2nd Month
A	1	1
B	1	$\frac{1}{2}$
C	1	$\frac{1}{4}$
D	1	0
E	1	and $\frac{1}{2}$ alternating
F	1	and $\frac{1}{4}$ alternating

Treatment	Total DDT	Cost per acre as Cash	Cost per acre as lb. seed cotton	lb. seed cotton/acre Total	lb. seed cotton/acre Net
A	8 lbs.	100/-	182	1,825	1,643
B	6 lbs.	75/-	136	1,535	1,399
C	5 lbs.	62/50	114	1,570	1,456
D	4 lbs.	50/-	91	1,250	1,159
E	6 lbs.	75/-	136	1,640	1,504
F	5 lbs.	62/50	114	1,545	1,431
Sign. Diff. (P = ·05)				306	

Part of this trial became waterlogged due to heavy rain during April and May and there was a wide plot to plot variation. The wetter parts suffered loss due to boll rots.

The "standard" treatment of 1 lb. DDT per acre per application gave the highest yield and the greatest net return.

Where the total amount of insecticide was reduced, either by applying lower rates in the second month or by alternating high and low applications, good control was still achieved. There seems to be an advantage in the "alternating" system over the simple reduction in the second month, although the yields were not significantly different. Neither of these variations gave the same economic return as the constant high rate.

Trial No. 2.

The inclusion of BHC in a spray is recommended as an insurance against possible aphid attack and to assist in the control of pink bollworm, which is not effectively controlled by DDT. This adds considerably to the cost of treatments if continued throughout the whole spraying period. It was considered that if cotton is planted relatively early so that the crop is near maturity at the end of the rains, an aphicide would only be needed during the last few weeks of treatment. A comparison was made between applications of DDT only, DDT plus BHC during two months, and the addition of BHC in the second month only.

TABLE XII

Treatment	1st Month		2nd Month		Total Insecticide	
	DDT	BHC	DDT	BHC	DDT	BHC
A	1 lb.	–	1 lb.	–	8 lb.	–
B	½ lb.	–	½ lb.	–	4 lb.	–
C	1 lb.	¼ lb.	1 lb.	¼ lb.	8 lb.	2 lb.
D	½ lb.	¼ lb.	½ lb.	¼ lb.	4 lb.	2 lb.
E	1 lb.	–	1 lb.	¼ lb.	8 lb.	1 lb.
F	½ lb.	–	½ lb.	¼ lb.	4 lb.	1 lb.

Treatment	Cost per acre as		Yield lb. seed cotton/acre	
	Cash	lb. seed cotton	Total	Net
A	100/-	182	1,932	1,750
B	50/-	91	1,536	1,445
C	230/-	418	2,068	1,650
D	180/-	327	1,612	1,285
E	165/-	300	1,904	1,604
F	105/-	191	1,668	1,477
Sign. Diff. (P = ·05)			272	

Unsprayed strips: Average 774 lb. seed cotton per acre.

Rainfall was heavy throughout the period of vegetative growth, and no appreciable aphid attack occurred. Pink bollworm did not cause serious damage. The addition of BHC in general led to slightly higher yields, but in no case were they significantly greater than DDT alone, and the treatments including BHC for the second half of the protection period were as effective as those in which BHC was used for the whole period. The higher (1 lb.) application of DDT again gave a better net return.

Trial No. 3.

Another possibility for reducing costs is the use of the cheaper locally formulated insecticides. A small trial, comparing a locally produced emulsion with an imported product, was therefore carried out. A comparison was also made of swirl nozzles, giving a fairly coarse spray, and fine ceramic nozzles. The results are shown in Table XIII.

TABLE XIII

All applications at 1 lb. DDT + ½ lb. BHC per week

Treatment	Insecticide	Nozzle	Cost/acre	Yield	
				Total	Net
A	Imported	Allman 000	230/-	2,900	2,482
B	Imported	Swirl	230/-	2,818	2,400
C	Local	Allman 000	128/-	2,254	2,021
D	Local	Swirl	128/-	2,358	2,125
Sign. Diff. (P = ·05)				429	

Yields from this trial were very satisfying as they represent the highest yields obtained from a standard insecticide treatment. The highest plot yield was equivalent to over 3,000 lb. seed cotton per acre.

All treatments gave very good control. The better quality insecticide gave the highest yields, and although much more expensive, also the greatest net return.

There was no significant difference between the "coarse" and "fine" sprays in final yields, but the pest records indicate that the coarse sprays may be a little more effective in the control of Spiny bollworm.

Insects.—Weekly recordings were made at district plots to trace the development of insect attack. Damaged buds (flared squares) were counted and an analysis of shed bolls was carried out. Information was obtained on the period of insect attack and an estimate of the damage done by the various insects on dusted and not dusted cotton was obtained.

As both flared-square and shed-boll counts bear a direct relationship with the total flowering points produced a comparative estimate of levels of insect attack at the various sites cannot be made.

Table XIV shows the period of pest attack and the proportional damage by the major pests. The results for undusted cotton only are shown.

TABLE XIV

Percentage of damage due to various insects at district plots

Undusted cotton planted in February

Site	Planting date	American Bollworms	Pink	Spiny	Stainers	Main Period of crop loss
Kisaki	8·2·57	23	6	27	44	15·4–6·7
Mikese	4·2·57	60	4	9	27	15·5–13·7
Ilonga	1·2·57	47	12	28	13	30·3–8·6
Miono	27·2·57	59	1	16	24	15·5–20·7
Handeni ...	23·2·57	36	13	50	1	1·6–27·7
Mwaya ...	22·2·57	25	20	18	37	4·5–22·6

All sites were later in developing pest attack than Ilonga, possibly due to a later planting date at Miono, Handeni and Mwaya and a six week dry period following planting at Kisaki and Mikese. 47/10 was planted at all sites except Handeni, where UK. 51 was used. UK. 51 is slower fruiting than 47/10 under local conditions and this could account for the later period of damage.

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Weather

Rainfall was exceptionally good and was reflected in the crop yields. Figures are given in Table I.

TABLE I

Rainfall at Coast Agricultural Station

Month	Inches	Days	(Figures for Bagamoyo, 6 miles from Chambezi) Average
January	4·25	12	3·47
February	8·55	8	2·61
March	6·84	11	4·07
April	8·76	19	9·14
May	9·94	19	7·51
June	2·11	6	1·53
July	0·60	4	1·27
August	1·14	5	1·16
September	0·52	5	1·02
October	2·45	6	1·28
November	8·11	13	3·16
December	3·08	8	4·12
Total	56·35	116	40·34

Coconuts

Hole size and Fertiliser Trial.—This is now in its fifth year and while most of the palms are growing extremely well and some have flowered no differences between treatments are yet evident.

3 x *3 Fertiliser Trial.*—This trial is in its fourth year. One block is growing well but the other, in rather swampy soil, is poor.

The experiment was scored for circumference of stem at 3′ 6″ height but no differences in treatments emerged.

Tapering Disease.—Material from healthy and "tapering" palms was sent for analysis to the Government Chemist in order to test for trace element deficiency but with no positive results. Injections of "tapering" palms with various minor elements in 1956 have not shown any responses to date and the attempt in 1956 to infect healthy palms by inoculating with root material from "tapering" palms has also given no obvious results.

In an effort to cure "tapering disease", soil, coconut husks and sticks were piled round six affected palms in 1956. Inspection now shows that these palms have all put out new roots above the original ground level and the trunks above the "tapered" portion appear to be growing out to normal thickness. Yields of nuts from these trees also appear to be on the increase.

Fertiliser Trial—Adult Palms.—Individual yield recording and copra conversion figures are being kept for this trial which was laid down in October, 1956, but significant results cannot be expected until 1958/59 at the earliest.

Theraptus Damage Trial.—An experiment to investigate the control of Theraptus has been started. It is hoped to effect biological control by encouraging the Maji Moto ant, (*Oecophylla longinoda*). To this end citrus, castor and guava are being planted in the rows of palms as nesting sites for this ant.

Self-Pollination.—Some thirty high yielding palms have been self-pollinated this year and the resulting seed is to be planted up in an isolated position as a seed producing unit for the future.

Other Crops

Cashew.—Yield recording of the five-year-old Portuguese East African and Zanzibar type trees was again carried out. The Southern Province cashew, now in its third year, gave a small yield. Helopeltis damage reduced yields considerably. There was great variation in yield from individual trees. The average yield for both Portuguese East African and Zanzibar types was about 10 lb. per tree, but individual trees yielded up to 50 lb.

Rice.—A non-replicated trial of 33 rice varieties gave preliminary information on yields and other characteristics.

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Agricultural Officer

COFFEE RESEARCH STATION, MBOZI

The year has in general been a disappointing one. The earlier hopes that the answer to Mbozi "Black-tip" and "Dieback" of coffee had been obtained, were not sustained by results. Indeed it became apparent that additional lines of approach to the problems were necessary.

Some progress has been made towards developing the station on a more general basis instead of the earlier concentration on coffee.

Weather

In the 1956-57 season the weather was generally helpful to crop growth. Although the rains started rather late, they continued satisfactorily until mid-May.

Rains began early in the 1957-58 season, but in November there was little rain and coffee suffered as a result. At the beginning of December there was a very heavy hailstorm which caused considerable damage.

Rainfall

	No. of days	Amount	Average for period
1.9.56—31.8.57 ...	... 121 ...	58·27″ ...	44·96″
1.9.57—31.12.57 ...	... 37 ...	13·69″ ...	11·35″

Coffee

A new trial of twelve varieties was planted in January, 1957. Growth has been poor and cutworm has caused severe damage. Many trees will have to be replaced.

Mulching Trial.—The mulching trial, planted in 1954, suffered badly from leaf fall and dieback during the dry season. No differences between the various treatments were evident. There was considerable improvement in the appearance of the coffee with the start of the 1957/58 rains.

Finalised results for the year are not yet available. Yields in terms of ripe cherry production per 36 trees are, however, presented in Table I.

TABLE I

Effect of sulphate of ammonia and mulch. Yields of ripe cherry in lb. per 36 trees
B. Banana trash mulch 20 lb. and 40 lb. per bush
H. Hyparrhenia mulch 20 lb. and 40 lb. per bush

Stem	Sulphate of ammonia	Control	B20	B40	H20	H40	Mean
Single	Absent	35·6	40·6	34·9	38·5	34·4	36·8
	Present	52·2	43·8	42·6	38·7	33·9	42·2
Multiple	Absent	47·9	52·0	60·4	80·9	72·2	62·7
	Present	55·4	68·5	76·5	48·9	60·0	61·9

Multiple stemmed bushes appear to be outyielding single stemmed bushes by some 50 per cent. The overall effect of sulphate of ammonia is slight but there may be responses from mulch treatments.

Pruning Trial (Planted 1954).—This experiment was also rather disappointing for reasons similar to those already quoted. The poor condition of the coffee did not appear to vary with treatments.

Total yields on the basis of ripe cherry are as follows:—

TABLE II

Treatment	Yield of ripe cherry lb./72 trees
A. Single stem capped twice	109·3
B. Single stem capped thrice	69·8
C. Normal method of conversion to multiple stem. 2nd cycle brought normally i.e. 2 years before 1st cycle is cut out and new cycle allowed	93·2
D. Normal method of conversion to multiple stem but 1st cycle to be removed at requisite time and then new cycle allowed up	94·9
E. As for single stem but not topped and later pruned as for multiple stem	148·5
F. Top at 18-20 ins., remove uppermost primaries and allow two suckers from this node. Leave all remaining primaries. The two suckers pruned as for multiple stem, except lowermost primary on each is left as lung branch	118·3

Fertiliser Trial (Planted 1956).—The condition and appearance of the coffee in this experiment has been good throughout the year. So far there do not appear to be any differences in response to the fertiliser treatments.

Latin Square Variety Trial (Old coffee plot).—The condition of this coffee during much of the dry season was poor. There was a large proportion of buni, accompanying leaf-fall and dieback. With the onset of the rains there was a great improvement and some varieties set a good crop.

Variety Plot (Planted 1956).—All varieties have been in good condition throughout the year.

Hedge Coffee Trial I (Planted 1956) and II (Planted 1957).—The general appearance and condition of the coffee has been good throughout the year.

Irrigation Plot (Planted 1956).—Growth and condition of the coffee has been generally good on the part which was adequately irrigated. The un-irrigated part was in poorer condition and showed less growth during most of the dry season. By the end of the year differences were more difficult to see.

Studies on rooting habit.—A study of root systems has indicated a restriction of root penetration to a depth of 2-2½ feet. It is generally found in the Mbozi area that coffee trees look well for the first few years, and lose condition after 2-4 crops, varying with the farm. It seems possible therefore that part at least of the problem of Mbozi coffee is associated with the loss of balance between the development of above and below ground portions of the trees.

It has not yet been possible to carry out any root studies on coffee off the station. Confirmation that Mbozi area coffee in general has restricted root systems is still awaited.

Off-Station Experiments

Variety Trial (Planted 1953).—There were considerable differences in yields of varieties. Finalised results are not yet available, but yield figures in terms of ripe cherry are presented in Table III.

TABLE III

Variety	Yield (lb./96 trees)
F839/3	267·2
N197	251·4
P280/2	209·7
N39	155·6
H61/71	108·8
H1/10	99·6
F840/4	84·4
F502/28	57·9

Fertiliser and Zinc and Boron Spray Trial.—This trial was laid down on bearing coffee towards the end of 1956. The fertilisers were to supply N, P, K and Ca; treatments being all four nutrients, all combinations of three of these nutrients and control, giving six treatments in all. One block was sprayed with zinc and boron, the other block was not.

Yield figures from the main fertilizer treatments are unfortunately not available. Yield totals of the sprayed and unsprayed blocks in terms of fresh cherry are as follows:—

Sprayed		*Unsprayed*
1,626·5 lb.	...	960·6 lb.

G. K. Reakes-Williams,
Agricultural Officer

GENERAL EXPERIMENTAL WORK, EASTERN PROVINCE

(A).—Mlali Irrigation Scheme

Rice Variety Trial.—The results are given in Table I.

TABLE I

Variety	Yield lb./acre
Afaa	5,592
Kahogo	5,200
Kikweta	5,072
Karafuu	2,752

Least significant differences: 5 per cent 1,163, 1 per cent 1,631.

Rice Date of Planting Trial.—Results are presented in Table II. Variety Afaa was used.

TABLE II

Date of planting	Yield lb./acre
21.12.56	3,720
19.1.57	3,344
13.2.57	2,488
4.3.57	1,312

Least significant differences: 5 per cent 631, 1 per cent 885.

As in 1956, yields became progressively smaller with later planting dates.

Paddy observation plots. 16 varieties (ex-Ukiriguru) were grown in observation plots.

Vegetable trials. Observations on vegetables from several different sources were continued.

(B).—Morogoro Farm

A cassava variety trial was planted in November, 1956. 14 varieties are included in the trial, which will be harvested early in 1958.

(C).—Mfumbwe

Observation plots using the following several methods of cultivation and soil conservation measures have been laid down:—

(1) Cored ridges.
(2) Live barrier hedges (Khuskhus grasses and *Leucaena glauca.*)
(3) Strip cropping: paddy and cowpea.
(4) Strip cropping: paddy and pumpkin.
(5) Trash bunding.
(6) Mgeta step terraces.
(7) Flat cultivation without soil conservation measures.

(D).—Kisaki Sub-Station

Five acres were cleared by April, 1957, and a variety of crops were planted for observation. Yields were low, probably because of late planting and excessively high rainfall in April.

D. W. Chambers,
Agricultural Officer

GENERAL EXPERIMENTAL WORK, SOUTHERN HIGHLANDS PROVINCE

Further investigations into varieties and fertiliser requirements of the most important crops have been made. Findings concerning wheat varieties have been fairly clear-cut, more information has been obtained on groundnuts, and trials have continued on maize and sunflower.

Weather

Rainfall has been average over the District, and the dry season was mild with few damaging frosts.

Rainfall in Inches

	Wangingombe	Njombe
1956:		
November	0·63	0·31
December	4·55	7·85
1957:		
January	8·42	7·08
February	4·53	7·76
March	6·17	10·50
April	2·50	8·51
May	—	1·04
June	—	0·05
July	—	—
August	—	—
September	—	0·03
October	—	—
November	—	0·10
Total	26·80	43·23

Uwemba Wheat Variety X Fertiliser Trial

Growth was good throughout the season but some damage was caused by soil wash through the plots and by rats when the crop was mature. It is thought that the damage was extensive enough to interfere with the results, since the standard error is very high. The results are shown in Table I.

TABLE I

Mean Treatment Yields in lb./acre

Varieties	
Sabanero	377
Regent	298
354	629
Phosphate	
No phosphate	370
100 lb./acre	414
200 lb./acre	520
Nitrogen	
No sulphate of ammonia	444
100 lb./acre	409
200 lb./acre	451
Significant Difference 5 per cent	168

Variety 354 outyielded Sabanero and Regent by about 300 lb./acre. Sulphate of ammonia did not improve yield and the response to double superphosphate was just not significant at the higher level.

Mtwango Wheat Variety X Manure X Fertiliser Trial

Germination and growth were even throughout, and the crop always looked healthy. A little rat damage occurred, but this was not serious. The results are given in Table II.

TABLE II

Mean Treatment Yields in lb./acre

Varieties	
Sabanero	1,102
Regent	1,152
354	1,613
Phosphate	
No phosphate	1,202
100 lb./acre	1,302
200 lb./acre	1,363
Manure	
No manure	1,308
5 tons/acre	1,327
10 tons/acre	1,233
Significant Difference 5 per cent	253

Variety 354 again outyielded Sabanero and Regent by almost 500 lb./acre. Superphosphate gave no response. Manure also gave no response, though in a trial on this site last year it increased yields by 50 per cent.

Ichenga Wheat Variety X Phosphate Trial

This trial was laid down with six of the most promising varieties from 1956 trials, with one level of double superphosphate. The varieties were: Regent, 354, Sabanero, 341, Equator, and 1066.

Growth was very even. Very little damage from rats was seen and since the soil at the site is of average quality, results can be said to be representative of the area. The results are presented in Table III.

TABLE III

Mean Treatment Yields in lb./acre

Variety	No Phosphate	150 lb./acre Superphosphate	Mean Yield
Regent	944	869	906
354	914	1,261	1,087
Sabanero	658	1,345	1,002
341	672	964	818
Equator	586	662	624
1066	624	828	726
Means	733	988	—

Significant Difference 5 per cent

Body of Table	Varietal Means	Phosphate Means
135	95	55

The variety 354 again just tops the list, but its reaction to superphosphate, though considerable, is not as great as that of Sabenero, whose yield has been doubled.

Wangingombe Maize Variety X Fertiliser X Manure Trial

Stalk borers caused some damage. The percentages of stems found to contain borers were as follows:—

	%
Eckstein	6·6
Early Pearl	3·5
Local Type	3·8

Growth within varieties was rather variable at the later stages, resulting in a high standard error and average yields were not up to these obtained in the 1956 Wangingombe trial. Results are shown in Table IV.

TABLE IV

MEAN TREATMENT YIELDS IN LB./ACRE

Varieties	
Eckstein	983
Early Pearl	774
Local Type	1,286
Phosphate	
No phosphate	961
100 lb./acre	1,176
200 lb./acre	906
Manure	
No manure	702
4 tons/acre	1,006
8 tons/acre	1,335
Significant Difference 5 per cent	416

The local variety yielded better than Early Pearl by almost 500 lb./acre, though it was just not significantly better than Eckstein. Manure at 8 tons per acre showed an increase in yield of 600 lb. per acre over control. Double superphosphate, rather surprisingly, did not affect yield at the levels tested.

WANGINGOMBE GROUNDNUT VARIETY X PHOSPHATE X TIME OF PLANTING TRIAL

Three of the best of last year's varieties were grown with two levels of double superphosphate and three times of planting. Planting dates were as follows:—

T1 19/12/56 (with first rains)
T2 29/12/56 (ten days later)
T3 8/1/57 (ten days later)

Growth was in general good, and little rosette disease was observed. The length of growing period of each variety varied, possibly due to the superphosphate treatments, but an average was as follows:—

LENGTH OF GROWING PERIOD IN DAYS

Variety	Planting Dates T1	T2	T3
B. 353	184	177	175
Kanyoma	224	217	213
Ave Red	194	190	189

Rainfall during the period of growth was as follows:—

	T1	T2	T3
Inches	23·15	21·62	21·24
Days of rain	54	49	48

The principal results are given in Table V.

TABLE V

MEAN TREATMENT YIELDS IN LB./ACRE

Varieties	
B. 353	1,061
Kanyoma	689
Ave Red	968
Phosphate	
No Phosphate	645
100 lb./acre	1,001
200 lb./acre	1,072
Time of Planting	
T1	951
T2	966
T3	801
Significant Difference 5 per cent	248

Varieties B. 353 and Ave Red yielded better than Kanyoma by about 320 lb./acre. 100 lb. of double superphosphate increased yield by about 350 lb./acre but 200 lb. supers increased yield by a further 70 lb./acre only.

The different times of planting had no significant effect on yield.

Yields were not very high, and this may have been partly due to the rather wide spacing used, which was 2′ 6″ between ridges and 6″ between plants.

Wangingombe Groundnut Variety X Manurial Trial

From the 1956 observation trial on 21 new varieties from Kongwa and Nachingwea, ten were chosen for further trial with and without manure. The trial was planted on the 16th January, and varieties harvested as they matured between 15th July and 20th August. Total rain falling during the growing period was 19·21 inches in 44 days. Table VI shows the main results.

TABLE VI

Mean Treatment Yields in lb./acre

Variety	Without Manure	5 tons/acre Manure	Mean Yield
B. 353 Upright	480	1,944	862
B. 727 Upright	564	1,086	825
Gambia Bunch Upright	528	856	692
B. 713 Upright	476	825	650
Kartum Semi Upright	626	600	613
Mwitunde Semi Upright	440	389	415
Ave Red Spreading	281	194	237
T.M.V.I. Spreading	212	187	200
Kanyoma Semi Upright	150	109	129
H.G.I. Semi Upright	42	112	77
Mean	380	580	

Significant Differences (5 per cent)

Body of Table	Varietal Means	Manure
264	187	83

The order of yield is different from that in the 1956 trial, but the first four varieties have now been high on the list for two years. Manure increased the yield of the upright varieties appreciably but had little effect on that of the semi-upright and spreading types.

Wangingombe Sunflower Variety Trial

Five varieties were planted with the local strain, with no fertiliser or manure. Growth was good, quality moderate and yields average. Yields are shown in Table VII.

TABLE VII

Mean Variety Yield in lb./acre

Variety	Yield
Large White	1,927
Local Type	1,813
Dwarf Jupiter	1,361
Mixed Giant Black and Dwarf Mixed (1)	1,267
Mixed Giant Black and Dwarf Mixed (2)	1,225
Iringa T.F.A. Seed	1,165
Significant Difference 5 per cent	459

Large White yielded slightly better than the local type. The other varieties tested gave relatively low yields.

Other Experimental Work

Cassava.—The cassava trial at Wangingombe continues with the 12 varieties of mozaic resistant cassava. All varieties appear healthy and little if any disease has been observed. The trial will be ready to harvest in 1958.

Cashew.—A small plot of cashew was planted at Wangingombe Investigation Unit, and, rather surprisingly, the trees flourished and showed no signs of wilting in the long dry season with its winds. It is doubtful whether the yield of nuts from trees grown at this altitude would be economic, but if the trees continue to thrive, they will provide useful shelter, and shade.

W. H. Andrews,
Agricultural Officer, Njombe

PYRETHRUM TRIALS, UWEMBA

The season was favourable for pyrethrum growing, although there were some frosts in July and August. None of these seriously affected any experiment.

The large series of soil type trials has now been completed, as has the Irrigation Trial and the Nutrient Requirements Trial.

Soil Type Trials.

A series of experiments involving nitrogen, phosphate and dung applications was laid down in 1955 on eight different soil types in the main North Uwemba pyrethrum area. Results for 1955 and 1956 are reported fully in the Annual Reports for those years. In the first year responses to phosphate and manure were frequently obtained. Residual effects in the second season were recorded on only one of the soil types (Bayldon's Red Soil).

The series was continued into its third year mainly to see if there would be any further residual effects on Bayldon's Red Soil. Such an effect was in fact shown by plots which had received 10 tons per acre of manure in 1955. Some of the more important results from this soil type are shown in Table I. On other soil types no third year residual effects were demonstrated.

TABLE I

YIELDS ON BAYLDON'S RED SOIL: LB. DRY FLOWERS/ACRE

(1) Residual effect of manure applied in 1955

No manure	5 tons/acre	10 tons/acre	Sign. Diff. (P=0·05)
448	444	532	56

(2) Total yields for three years from manure applied in 1955

No manure	5 tons/acre	10 tons/acre	Sign. Diff. (P=0·05)
1,311	1,232	1,359	162

(3) Total yields for three years from superphosphate treatments

No phosphate	100 lb./acre 40% superphosphate	200 lb./acre 40% superphosphate	Sign. Diff. (P=0·05)
1,243	1,304	1,555	162

Although no residual response was obtained this year from superphosphate, over the three years of the trial a total yield increase of about 250 lb./acre has been obtained from the original application of 200 lb./acre of 40 per cent superphosphate.

The residual responses demonstrated on Bayldon's Red Soil may perhaps be related to its superior physical structure. On this soil higher dressings of fertilizer and manure might be economic.

Mean yields from trials on other soil types confirm previous years' observations on the general superiority of volcanic over non-volcanic soils, and of newly broken land over land which has previously grown pyrethrum. The lower yields obtained from old pyrethrum land have not yet been satisfactorily explained. Factors other than deficiency of the three main plant nutrients appear to be involved.

Nutrient Requirement Trial (South Uwemba).

This trial was started in 1955 to run concurrently with the Soil Type trials in North Uwemba and to serve as a guide to the application of these results to the southern area.

Yields were recorded in the third season of this trial, to assess any residual effects. In the second season a significant residual response had been obtained from superphosphate.

Phosphate treatment yields for the three years of the trial are presented in Table IV.

TABLE IV

YIELDS/ACRE IN LB. DRY FLOWERS

Treatment	1955	1956	1957	Total
No superphosphate	155	808	850	1,813
Superphosphate (40 per cent P_2O_5) 150 lb./acre	245	946	835	2,026
Superphosphate (40 per cent P_2O_5) 300 lb./acre	280	985	851	2,116
Sign. Diff. (P=0·05)	30	58	N.S.	111

There was no residual effect from superphosphate in the third season. Taking the three seasons together the original dressing of superphosphate at 150 lb./acre has given a total yield increase of 206 lb. dried flowers per acre.

No response was obtained, even in the first year, from nitro chalk or mulching.

Cropping cycle trial.

A trial was planted in 1956 to investigate the yield differences between pyrethrum on new land and after a previous pyrethrum crop. The trial involves an identical repetition on the same site of a spacing × lime × phosphate experiment carried out from 1950-53 on new land. The plots and treatments are repeated in exactly the same positions as in the old trial with the exception that no further lime has been applied. Any effects shown by the lime treatment would therefore be residual from the applications made in 1950.

In 1954 and 1955 the area was fallow, under a rather poor grass cover.

Comparisons of yields during the first and second years of the first cropping cycle (on newly broken land), and of the second cycle (old pyrethrum land) are given in Table V.

TABLE V

YIELDS/ACRE IN LBS. DRY FLOWERS

	First Cycle		Second Cycle	
	1950 (1st year)	1951 (2nd year)	1956 (1st year)	1957 (2nd year)
No phosphate	662	1,368	289	486
150 lb./acre 40 per cent superphosphate	697	1,323 NS	288 NS	464 NS
300 lb./acre 40 per cent superphosphate	838**	1,486	309	504
No lime	777	1,420	292	473
2 tons/acre (in 1950)	700 NS	1,367 NS	286 NS	491 NS
4 tons/acre (in 1950)	725	1,391	302	490
6″ spacing	842**	1,412	323	487
9″ spacing	695	1,378 NS	281 NS	479 NS
12″ spacing	660	1,387	276	488

Highly significant differences from phosphate and spacing treatments were shown in the first year. No significant differences have been found in other years.

It appears that two years' resting period is inadequate, and that yields after this period of rest are considerably less than those from newly broken land.

Continuous Phosphate Trial.

An investigation of the effect of annual phosphate application, as compared with a large single dressing at planting, was started in 1956. The soil was a poor red loam overlying a granitic subsoil. Analysis of the individual 1956 and 1957 results has shown no significant differences, but a combined analysis of the two seasons' yields has given some interesting results (Table VI).

TABLE VI

YIELDS/ACRE IN LB. DRY FLOWERS

Combined Results from 1956 and 1957 Seasons

Treatment	Yield—lb. dry flowers/acre
No superphosphate	299
200 lb./acre superphosphate (40 per cent P_2O_5) at planting	414
300 lb./acre superphosphate (40 per cent P_2O_5) at planting	285
50 lb./acre superphosphate applied annually ...	404
75 lb./acre superphosphate applied annually	326
Significant Difference (P=0·05)	95

200 lb. of superphosphate applied at planting, or 50 lb. applied annually, have given significant yield increases. 300 lb. of superphosphate at planting, or annual dressings of 75 lb., have, however, produced yields very close to those of the control plots. The reasons for these rather anomalous results, particularly the low yields obtained with 75 lb./acre of superphosphate applied annually, are not clear.

Picking Trial.

A trial was laid down on adult pyrethrum to compare three methods of harvesting. The soil was a volcanic ash. Treatments tested were:—

A. Picking all flowers and buds with petals visible, with about four weeks between pickings.

B. Picking only opened flowers (flowers with horizontal petals and at later stages of maturity), with about three weeks between pickings.

C. Selective picking of fully mature flowers only, with about two weeks between pickings.

No significant differences between picking methods were found, although method (B) gave slightly higher yields than (A) or (C).

Micronutrient Trial.

A further trial investigating the effects of micronutrients on pyrethrum was carried out, in collaboration with the Government Chemist. Zinc, boron and iron chelate foliar sprays were applied, with and without a basal fertilizer dressing of superphosphate, gypsum, and 1 lb./acre of sodium molybdate.

No significant differences between any treatments were recorded.

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Agricultural Officer, Njombe

REGIONAL RESEARCH CENTRE, UKIRIGURU

RAINFALL

Year	Month	Rainfall in inches	No. of days
1956	October	1·10	5
	November	3·32	9
	December	4·32	8
1957	January	5·01	11
	February	4·11	7
	March	3·78	12
	April	8·22	16
	May	3·70	6
	June	1·74	2
	Total	35·30	76

Rainfall during the 1956/57 season was very good. There was a dry spell during the second half of February but such dry spells are a frequent feature of the Lake Province climate. The heavy rain recorded early in June was unusual.

The mbuga lands were waterlogged at times, affecting yields on some of the sorghum trials.

COTTON

Time of Planting Trial.

In the Ukiriguru time-of-planting trial there was no difference in yield between mid-November and mid-December planting. In practice mid-November planting is too early, as in most seasons cotton sown at this date would come to maturity before the end of the rains. Cotton planted in mid-January yielded about 20 per cent less than the November/December planted plots, and mid-February planting produced only about half of the November/December yield. This tendency towards lower yields at the later planting dates was also apparent from observation trials on district plots.

The general recommendation is that land should be prepared in November, and that as much planting as possible should be accomplished by the end of December.

Land Resting.

Trial (6) was carrying the third indicator crop of the second cycle. Cotton following fallow still showed an increase of about 45 per cent in yield over the continuously cropped control, though differences were not significant. This trial has been discontinued.

A one season fallow treatment trial, Trial (41) was carrying a first year indicator crop; yields were significantly less after a clean bare fallow than after cropping, but a one year "tumbledown" fallow gave a significantly increased yield.

In Trial (36) the second indicator cropping after one season's fallow, there was still a suggestion of a "tumbledown" fallow benefit. There were no significant responses in Trial (31) carrying the third crop after one season's treatment.

Manuring and Fertilising.

The results obtained at Ukiriguru this season have been almost entirely in line with those of previous years. Long continued responses to the use of cattle manure on the hill sands have again been demonstrated, and highly significant increases have been obtained from phosphate and nitrogen treatments. A strong interaction between the effects of nitrogen and phosphate is evident. It appears that there must be sufficient phosphate available for nitrogen dressings to be effective. With adequate phosphate, responses to nitrogenous top dressings are very impressive.

The basic work at Ukiriguru on the effects of manurial treatments is now nearing completion. Future work, directed towards a more complete understanding of the results, will be mainly the responsibility of the soil science section.

Trial (8), discussed in previous reports, was planted to cotton. The trial was started in 1944, the original treatments used being two levels of compost and manure application, and cotton seed ash at 1½ tons/acre. In 1952 additional treatments were introduced, using split plots. Halves of the plots which received compost or manure in 1944 were given a further dressing every third year at the same rate. Halves of the control and cotton seed ash treatment plots received an annual dressing of 175 lb./acre of sulphate of ammonia.

This season, half plots which had received compost or manure at the lower rate of application in 1944, and which did not receive a second treatment with compost or manure in 1952, were given 75 lb./acre and 150 lb./acre of double superphosphate respectively. It was considered that the original 1944 dressings would have been exhausted.

The results are given in Table I.

TABLE I

UKIRIGURU HILL SAND—MANURIAL TRIAL (8)

1944 Treatments	Yield of Seed Cotton in lb./acre		
	Thirteenth indicator crop	Second indicator crop second re-application	Yearly applications Nitrogen
	Treatments applied 1944	Treatments re-applied 1952 and 1955	Sulphate of Ammonia 175 lb. p.a.
Control—no manure	339	—	494
Initially, compost—3 tons/acre—now 75 lb./acre double superphosphate	341	(Compost) 673	—
Initially, farmyard manure—3 tons/acre—now 150 lb./acre double superphosphate	485	(FYM) 690	—
Compost—7 tons/acre	488	721	—
Farmyard manure—7 tons/acre	542	1,073	—
Cotton seed ash—1½ tons/acre	639	—	1,080
Least Sign. Diff. 5%			
Treatments in same column	153	258	258
Treatments in same line	—	184	—
Treatments not in same line or column	—	209	—
Coefficient of Variation	—	32·6%	—

Significant residual responses from the heavier dressings of manure, compost, and cotton seed ash, applied in 1944, are still being obtained. Residual responses from the 1952 and 1955 dressings are also in evidence, particularly from the application of 7 tons/acre farmyard manure. This season, sulphate of ammonia produced a small, non-significant increase in yield, on plots which have received no organic manure. Sulphate of ammonia applied to the residual ash plots has, however, raised the yield from 639 to 1,080 lb.

Trial (9), the results of which are shown in Table II, is a 2 × 3 × 2 factorial experiment investigating the effects of nitrogen, phosphate, and compost. Phosphate and compost are applied every third year, while nitrogen applications are made annually. Although phosphate and compost were applied this year, the responses from these treatments will include residual effects from previous applications in 1950/51 and 1953/54.

Treatments were as follows:—

no, n,	Nil, 90 lb. area/acre annually, half at time of ridging, half applied as top dressing.
do, d,	Nil, 6 tons compost/acre, every three years.
Po, P_1, P_2,	Nil, 75 lb., 150 lb. basic slag/acre, every three years.

TABLE II

UKIRIGURU HILL SAND TRIAL (9) (NITROGEN × PHOSPHATE × DUNG)

Mean yields: Seed cotton lb./acre

	no do	n	d	nd
Po	779	998	1,466	1,803
P_1	907	1,285	1,437	1,856
P_2	1,021	1,468	1,522	1,842

Sign. Diff. (P=·05) All comparisons 176

Coefficient of Variation ... 17·3 %

Main effects:	N	P_2	D
	+353	+202	+578
Sign. Diff. (P=·05)	72	88	72

The heaviest NP application gave a yield exceeding that of the control plots by about 700 lb./acre. Compost gave a yield increase of the same order.

Results from Trial (26) are presented in Table III. This trial, investigating the response from compost, superphosphate, and nitrogen, has given results rather similar to those of Trial (9). Superphosphate and compost are applied every three years (applications were made in 1952/53 and 1955/56) and nitrogen at four different rates has been applied annually.

There are again impressive residual effects from the phosphate and compost applications made in the 1952/53 and 1955/56 seasons, and a strong interaction between nitrogen and phosphate.

TABLE III

UKIRIGURU HILL SAND TRIAL (26) (COMPOST × PHOSPHATE × NITROGEN)

Po, P1 — 0, 150 lb. double superphosphate/acre applied every third year.

do, d1 — 0, 6 tons compost/acre applied every third year.

no, n1, n2, n3. 0, 50, 100, 200 lb. sulphate of ammonia/acre applied annually.

MEAN YIELDS: SEED COTTON IN LB./ACRE

Nitrogen treatments (Applied each season)	Second indicator crops from dressings of compost and phosphate			
	doPo	d1	P1	P1d1
No nitrogen	427	981	574	1,048
50 lb./acre	601	1,046	875	1,042
100 lb./acre	581	1,131	890	1,294
200 lb./acre	611	1,128	1,023	1,405

Sign. Diff. (P=·05) Treatments in same column 178.
Treatments in different columns 198.

Coefficient of Variation=23·4 per cent.

Main effects:	P	D	N_2
	+205	+437	+217
Sign. Diff. (P=·05)	130	130	90

Comment has been made in previous years that Trial (38), a study of the effects of various rates of application of nitrogen and phosphate, was on land too rich to show marked responses. This year the control plots yielded 1,143 lb. of seed cotton per acre. No significant residual response from phosphate applied in 1954/55 was obtained, and the highest nitrogen response was only 200 lb. per acre. This trial will be discontinued.

Ridge Tying.

Rainfall during the 1956/57 season was excellent, both with regard to total amount and distribution. On Ukiriguru there was no difference between tied and not tied ridges where cotton was the indicator crop. There was a suggestion of better yields, as a result of tying,

with bulrush millet. These ridge-tying experiments at Ukiriguru are now being discontinued. It is abundantly clear that over the years, more especially with cotton, ridge-tying is very worthwhile. This is now generally accepted.

At Lubaga, on cemented hard pan soil ("Ibambasi") there was a considerable response to the ridging, both with cotton and sorghum. With cotton the crop was almost double that resulting from flat cultivation.

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FIGURE II
SOIL NITRATE UNDER COTTON 1956-7.
NO COMPOST APPLIED

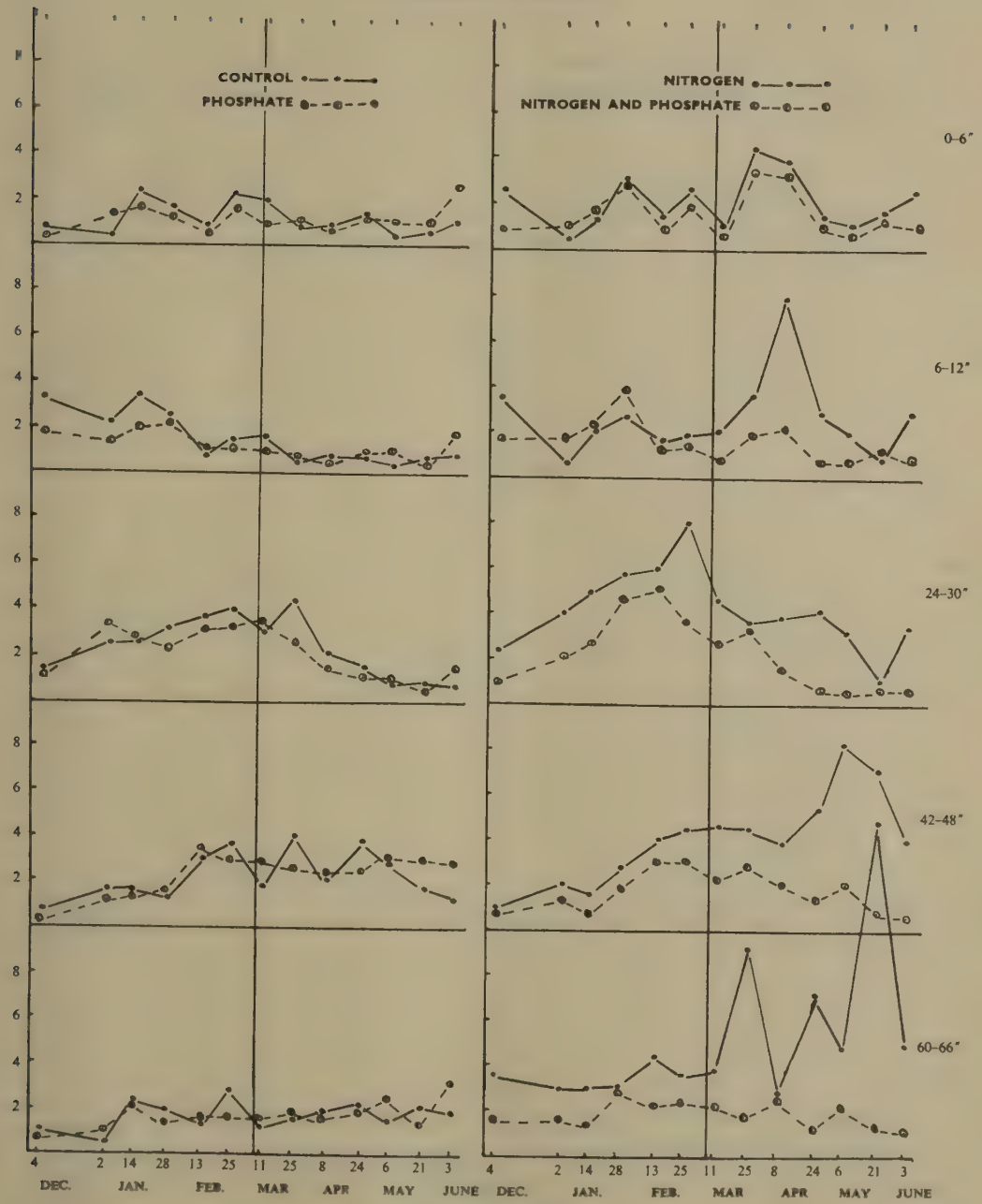
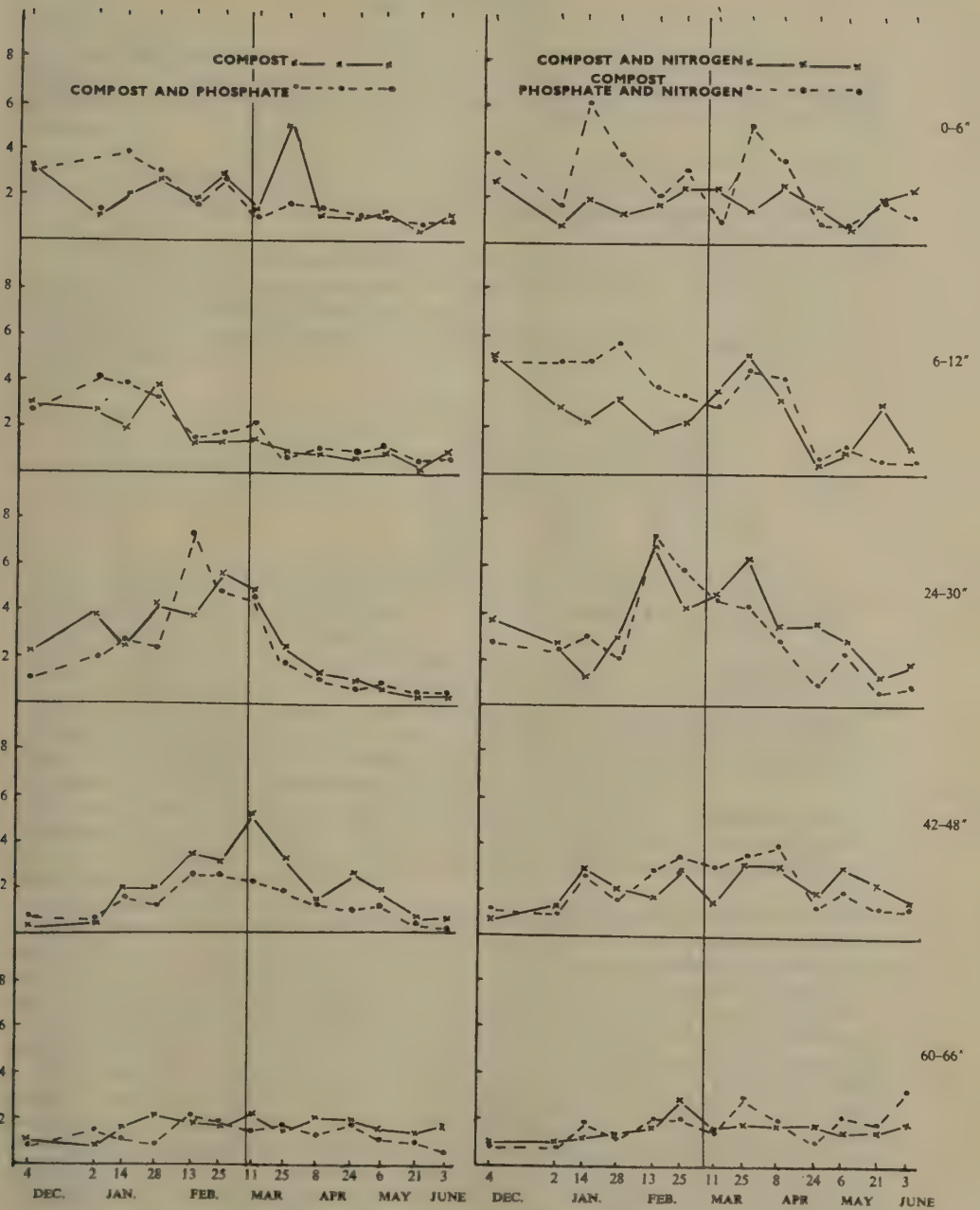


FIGURE III
SOIL NITRATE UNDER COTTON 1956-7.
SIX TONS PER ACRE COMPOST APPLIED IN 1955.



SOIL SCIENCE

Soil Nitrate Studies.

A study was made during the 1956-57 season of the fluctuation and movement of soil nitrate under a cotton crop in an NPD trial, Trial (26). Soil samples were taken at approximately fortnightly intervals from all the combinations of the following three treatments:—

n: Sulphate of ammonia at 200 lb./acre applied on 9th March, 1957. A similar application was given to the previous crop in February, 1956.

p: Double superphosphate at 150 lb./acre applied to the previous crop in November, 1955.

d: Compost at 6 tons/acre applied to the previous crop in November, 1955.

The sampling depths on each occasion were 0-6″, 6″-12″, 24″-30″, 42″-48″, and 60″-66″. Only replicate III of the experiment was used.

The final yields of seed cotton for the treatments studied are given in Table IV, both for replicate III and for the Trial as a whole.

TABLE IV

	Replicate III		Whole Trial	
	Nil	n	Nil	n
Nil	487	765	427	611
p	596	1,083	574	1,023
d	1,035	1,283	981	1,128
pd	1,061	1,457	1,048	1,405

The yields shown in both parts of Table IV are similar except that the yield resulting from the use of N alone was rather higher in the replicate III than the mean yield given by this treatment over the whole trial.

The variations in soil NO_3-N throughout the season for N and P treatments in the absence of compost are shown in Figure II, and in the presence of compost in Figure III.

(a) Compost absent (Figure II): Where fertiliser nitrogen was not applied, the graphs for treatments with and without P are very similar. There was a small accumulation of nitrate at 24″-30″ and 42″-48″ up to March, but thereafter the value for NO_3-N was very low throughout the soil, about 1 ppm in the upper layers, and 2 ppm at depth.

On plots which received nitrogen there was evidence in February of residual N from the application of the previous season. At 24″-30″ the peak NO_3-N values in the absence and presence of P were 8 ppm, and 5 ppm respectively, about twice the amount present on plots which had no N in the preceding year.

About a fortnight after the application of ammonium sulphate in March 1957, there was an increase in NO_3-N at 0-6″ on both P and no P plots, but by the end of April surface nitrate was reduced to 1 ppm. In lower zones the amount of NO_3-N present depended upon whether or not P had been given. On the P plot the NO_3-N value fell in April to about 1 ppm at all levels. In the absence of P there seems to have been an excess of nitrate over crop uptake, as indicated by peaks on the graphs which occur in the successive zones at approximately fortnightly intervals. However no sharp peak is shown for 24″-30″; the sampling is assumed to have missed this. The data help to explain the yields obtained from the Trial, which indicate that the presence of phosphate is necessary for effective utilization of added nitrogen in the hill soils at Ukiriguru. The soil nitrate data suggest that if phosphate is not given nitrate surplus to crop uptake accumulates in the soil. The data also indicate that the time of application of ammonium sulphate was correct, at a time when the early accumulation of nitrate at about 24″ was being used rapidly by the plants and the soil nitrate was falling in all zones of the soil. On the phosphate plot there was clearly a heavy demand for nitrate in late March since the applied ammonia sulphate was detected in very small amounts only.

(b) *Compost present* (*Figure III*).—In the absence of added nitrogen, compost appears to have had little effect in increasing the quantity of soil nitrate surplus to the uptake by the crop, the graphs being very similar to those obtained in the absence of compost.

On the plots receiving added nitrogen the status of surplus nitrate in *nd* and *npd* plots was, throughout the season, very similar to that in the *np* plot. As with phosphate, compost appears, from the evidence of soil analysis, to have permitted greater uptake of added nitrogen by the crop, no accumulation being found in the soil. (It will be noted from the trial yields that compost must be providing reasonable quantities of nitrogen as well as phosphate). Thus the NP_2 responses in Table (2) and Table (3) are roughly equivalent to the compost responses, though a further response is obtained on addition of nitrogen. This finding is however at variance with the yield data, for the increase due to N on the compost plot without phosphate was similar to the increase due to N on the plot without either compost or phosphate. Luxury consumption may have occurred but as uptake of N by the crop was not determined this can only be considered as a possibility. Chemical analysis of plant samples is planned for the coming season in an attempt to elucidate this problem.

The compost was applied in 1955 to the previous cotton crop. At the time of planting the cotton crop discussed in this report (December, 1956), soil samples were taken and analysed for total nitrogen. The only treatment found to have influenced total nitrogen was the application of compost. The data for this treatment are given in Table V.

TABLE V

TOTAL N PERCENTAGE IN SAMPLES FROM TRIAL (26), DECEMBER, 1956

	Compost	
	None	6 tons/acre applied in November, 1955
0—6″	0·025	0·030
6″-12″	·023	·025
24″-30″	·020	·022
42″-48″	·021	·020
60″-66″	·015	·017

Compost has increased the total nitrogen of the surface soil. However, since no nitrate accumulation was detected during the season and since the crop responded to added nitrogen in the presence of compost, it seems that the rate of nitrification of the increased total nitrogen was inadequate, particularly where phosphate was given also.

The compost was applied before the present work was started so that a sample of it was not obtained. However, compost and other cattle manure made at Ukiriguru is now being sampled and analysed. An estimate of the quantity of minerals applied can now be made.

Soil and plant analyses are also in hand to investigate the effects of cattle manures and fallows on nutrients other than nitrogen.

Soil Moisture.

In December, 1956, nylon electrical resistance units for assessing soil moisture were placed at 6″, 12″, 24″ and 36″ from the surface of the furrow, the side of the ridge and from the top of the ridge. Similar sets were placed in flat cultivated land. Cotton was grown on all sites. Soil moisture assessment were made throughout the growing season.

On ridged land soil moisture was apparently adequate during January, the resistances being 3·0–3·5 log ohms, and little change occurred until the dry spell in February. During this month the resistance of all units below the side and top of the ridge rose steadily to 4·0 to 4·5 log ohms. Under the furrow, however, there was little change, except in the units at 6″.

Rain on the 5th and the 10th March (0·7″ and 1·9″ respectively) caused a general drop in resistance of units below the side and top of the ridge, with the exception of those at 36″ below the top of the ridge. In the latter part of March there was little rain and resistances tended to rise until further rain fell early in April. Thereafter soil moisture was apparently adequate until mid-June when rainfall ceased and resistances began to rise slowly.

Below the furrow there appears to have been little change in soil moisture, the variation in resistance being confined principally to the units at 6″. Water removal by the crop seems to have occurred mainly from the ridges and little of the reserve below the furrow seems to have been tapped. This is a most important observation. It is clear that moisture is removed from at least 3 feet below the ridge during a dry period by a cotton crop two to three months old. Further work with resistance units is necessary and root studies are highly desirable.

On flat land the moisture status during the February dry spell appeared to be rather lower than under the furrow, but somewhat higher than under the ridge.

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COTTON BREEDING

The cotton breeding work described in this Report may be considered under two main headings. Firstly, progress with the straight selection and testing of AR Mwanza material is reported; secondly, work undertaken with the object of adding bacterial blight resistance to standard Ukiriguru strains is described in the "Cotton diseases" section of this Report.

Appendix I shows the origin or parentage of the various strains referred to.

Selections from AR Mwanza material are being tested against the parent strains in balanced lattice trials at Ukiriguru and Lubaga. Comparisons of cropping habit, maturity period, and lint quality, as well as yield, have been made. Promising material has been sent to the Shirley Institute for evaluation and spinning tests. Yield differences between strains were not so marked as in some of the district plots, but from spinning and fibre tests it appears that some segregates are giving better yarn than UK. 55. One of the best selections in field tests, 55/106, ex 0/334, just significantly outyielded UK. 51 and UK. 55 and had a yarn appearance grading of 1½ as compared with a grading of 3 in respect of UK. 55.

Some segregates from 8/290 have been shown to possess a fair degree of blackarm resistance, and some resistance to bacterial bollrot. This latter resistance may be of particular value.

It had been proposed to constitute a new issue, UK. 57, on the basis of yield performance in trials, but as sufficient seed is available the lines are being bulked separately, and will undergo a further year of testing before being used to constitute UK. 58.

In the 7 × 7 lattice trial at Ukiriguru, the strain No. 56 from Namulonge gave a significantly lower yield than the control, UK. 51.

A comparison of UK. 51 from "elite" stocks, grown at Ukiriguru, and from commercial seed was carried out. No deterioration of the commercial material was evident either with regard to yield or fibre quality.

Yield results from district plot 4 × 4 lattice trials in the Lake Fringe area are presented in Table VI. Yields from UK. 51, the control variety, range from 1,200 to 1,800 lb. seed cotton per acre. Lines 0/328, 0/334 and 1/667 have performed well. 0/95, one of the last surviving representatives of the 5/57 family ex 3/17, has a small seed and a high ginning percentage. 1/686 (ex Barberton U4 × Sea Island) has a low ginning percentage.

Results from seven inland district plots are shown in Table VII. A feature of the season was the unusually high yields obtained in these areas. For simplicity of presentation, yields of seed cotton/acre are given. The mean ginning percentages shown are in respect of Grade A seed cotton. Percentages of Grade C cotton produced by each variety are shown separately.

The multiplication of UK. 55 on Kome Island in its second season had to be discontinued because of the presence of *Fusarium* wilt there. A fresh multiplication has been started this season near the Bukumbi Ginnery.

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TABLE VI

	4 Lake Fringe Plots—Yield Seed Cotton lb./acre				Mean Yield lb./acre	Mean Ginning Percentages (Grade A Seed Cotton) %	Lint as percentage mean of UK. 51
	Geita Arugongo	Mwanza (Nassa) Shigala	Musoma Suguti	Ukerewe (Mainland) Lagata			
MZ. 561	1,093	976	1,057	1,710	1,209	32·4	85
UK. 46	1,065	1,158	1,081	1,772	1,269	34·0	94
UK. 48	1,123	1,190	1,051	1,776	1,285	34·1	96
UK. 51	1,196	1,223	1,208	1,928	1,389	33·3	100
BK. 51*	1,220	1,101	1,271	1,807	1,348	33·9	
UK. 55	1,170	1,206	1,202	2,031	1,402	34·5	106
UK. 55	1,204	1,374	1,160	2,049	1,447	34·3	108
8/290	1,184	1,129	1,333	1,930	1,394	33·3	101
0/95	1,077	1,170	1,101	1,667	1,254	36·4	100
0/308	1,057	968	1,049	1,869	1,235	32·4	87
0/328	1,317	1,166	1,172	2,057	1,428	33·9	105
0/334	1,283	1,257	1,228	2,207	1,494	34·3	112
0/334	1,243	1,105	1,142	2,043	1,383	34·1	103
1/667	1,245	1,210	1,107	2,094	1,414	34·4	106
1/686	1,170	1,265	1,113	1,954	1,375	32·2	97
2/25	1,137	1,136	941	1,926	1,285	34·2	96
Sign. Diff. from mean of UK. 51 (P = 0·05) ...	110	148	133	210			
Coefficient of variation	8	11	11	10			
Percentage of Grade C ...	8	9	16	20			

*BK. 51: Commercial UK. 51 Seed ex Bukumbi Ginnery.

Strains UK. 55 and 0/334 were included twice to allow the use of a 4 × 4 balanced lattice design.

TABLE VII

	7 Inland District Plots—Yield Seed Cotton lb./acre							Mean Yield lb./acre	Mean Ginning Percentages (Grade A Seed Cotton) %	Lint as percentage mean of UK. 51
	Shinyanga		Kwimba		Maswa					
	Butulwa	Lagana	Mabuki	Ilula	Somanda	Luguru	Lalago			
MZ. 561	502	562	643	739	1,073	1,109	422	721	33·0	73
UK. 46	507	616	776	777	1,166	1,229	614	812	34·2	85
UK. 48	604	645	780	684	1,191	1,146	748	828	34·6	88
UK. 51	586	721	800	884	1,332	1,485	899	958	34·2	100
BK. 51*	679	734	907	804	1,389	1,261	742	930	34·4	
UK. 55	679	903	1,006	966	1,368	1,550	992	1,066	35·3	116
UK. 55	729	857	917	877	1,396	1,431	1,127	1,047	35·4	114
8/290...	844	724	855	889	1,350	1,380	845	983	34·4	105
0/95	560	611	770	728	1,380	1,220	655	846	36·2	95
0/308...	436	614	838	672	1,234	1,297	630	817	33·3	84
0/328...	602	713	891	838	1,473	1,507	1,055	1,011	35·1	110
0/334...	769	804	1,129	953	1,317	1,437	992	1,057	35·6	116
0/334...	688	849	1,034	844	1,380	1,534	917	1,035	35·5	114
1/667...	688	717	1,127	946	1,285	1,437	1,111	1,044	35·5	115
1/686...	621	760	960	853	1,261	1,430	1,000	983	33·6	101
2/25	646	705	933	748	1,586	1,426	826	981	35·1	106
Sign. Diff. from mean of UK. 51 (P=0.05)	95	89	135	116	186	196	145			
Coefficient of variation	15	11	14	13	13	13	15			
Percentage Grade C	29	13	16	14	7	15	29			

*BK. 51: Commercial UK. 51 Seed ex Bukumbi Ginnery.

Strains UK. 55 and 0/334 were included twice to allow the use of a 4 × 4 balanced lattice design.

Bacterial Blight (*Xanthmonas malvacearum*).

Hybrids Resistant to Bacterial Blight.—Testing of the wide range of strains produced by selection in Albar 51 hybrid material continued. 161 selections made in 1955 were compared with UK. 55 in strain trials on Ukiriguru (Trials A-E) and 45 selections made in 1956 were included in replicated progeny rows (Trial F). The distribution of lint yields is shown in Table VIII. It will be seen that in many selections yields comparable with that of UK. 55 have been achieved, and in a few this has been surpassed. Re-selections from the higher yielding strains will be planted in the coming season. Many of the poorer strains have been discarded.

Lint samples from 31 of the better strains were sent to the Shirley Institute for testing. Most of those sent were derivatives of third backcrosses and in general the reports showed improvement on last year when strains derived from first and second backcrosses were sent. The fibre characteristics of these strains had shown a tendency for the Albar hybrids to be slightly shorter and coarser than the standard Ukiriguru strains and to give yarns which were in general somewhat weaker (though there were exceptions). In this year's testing the fibre characteristics of the hybrids in the majority of cases compared favourably with UK. 55 and several gave stronger yarns. In Trial B where UK. 55 gave a corrected lea count strength product of 1940, six out of the ten hybrids tested gave counts of over 2,100 and the yarns of all but one of these were of better appearance than UK. 55.

In the coming season a range of Albar hybrids will be tested against the most advanced "Local" strains in station and district variety trials.

Both this season and last season the comparative earliness of many of the Albar hybrids has been noted. Expressing earliness as the proportion of its final yield of seed cotton which a particular strain had yielded by a given picking (chosen to be such that the control, UK. 55, had a value of approximately 75 per cent) correlation diagrams for yield and earliness were prepared for all strains in trials B and D. (On this basis, the hybrids ranged from 62 per cent to 92 per cent). Although, in most cases, the diagrams indicated that UK. 55 was both higher yielding and later than the mean of all strains represented, there was no apparent overall relationship between earliness and final yield. This inference must be treated for the moment with some reserve owing to the fact that under this season's conditions there was, as a generalisation, only a limited development of the top crop. Picking on Ukiriguru, which can in some seasons extend into September, was largely completed in mid-July. Three high yielding Albar hybrids, covering the main range of earliness represented in the material, will be included as sub-treatments in the time of planting trial next season in order to obtain some information on the advantages and disadvantages of this character.

Third backcross progenies from the programme in which BAR 14/38 (B_2B_6m) was used as the source of resistance, were disappointing. "Off types", typical of those often found in *hirsutum x barbadense* hybrids were of frequent occurrence. Forty-six resistant plants which were also jassid resistant and of good appearance were selected for further backcrossing.

The strain BAR 12/16, having the gene combination B_2B_6m on a *hirsutum* background, has recently been obtained from Shambat—for which grateful acknowledgment is made. A few crosses with this will be made next season using the best available "Local" strains and Albar hybrids.

A large number of plants in both Albar hybrid and BAR 14/38 hybrid material were boll-inoculated using the technique developed by Logan. Fifty single plants, which appeared to be resistant, were selfed and their progenies will be studied in the coming season.

Resistance in Strains of Local Origin.

The work begun last season was extended and a wide range of strains was tested for resistance. The results, which have been written up in detail elsewhere (Arnold, 1957) showed that selection for high yield in "Local" stocks has been associated with increases in resistance to bacterial blight. An extract of the results for stem inoculation is shown in Table IX which illustrates the advantage of UK. 55 in stem resistance over previous seed issues.

TABLE VIII

Albar Hybrid Strain Trials and Replicated Progeny Rows

Trial	Design	Distribution of Lint Yields—per cent Control (UK. 55)																Hybrids outyielding controls—Significant at P=0.05 (approx)*	Mean Yield of Controls Lint—lb./acre	Coefficient of Variation (Seed cotton data) %
		60—64·9	65—69·9	70—74·9	75—79·9	80—84·9	85—89·9	90—94·9	95—99·9	100—104.9	105—109·9	110—114·9	115—119·9	120—124·9	125—129·9	130—134·9	135—139·9			
A	5×5 balanced lattice (2 controls)					3	4	7	4	5								0	585	11·9
B	5×5 balanced lattice (2 controls)				1		6	3	6	1	3	3						1	584	12·9
C	5×5 balanced lattice (2 controls)		1	1	4	4	5	2	5	1								0	639	13·4
D	7×7 balanced lattice (4 controls)				3	3	5	10	13	5	2	2	2					4	415	11·6
E	7×7 balanced lattice square (2 controls)	1		1	1	3	1	6	7	12	4	3	2	4	1	1		2	177	20·9
F	7×7 balanced lattice square (4 controls)—replicated progeny rows		1	1	1		2	4	4	9	8	4	4	6			1	9	498	15 7

*All lint yields are calculated from seed cotton yields using ginning percentages determined from duplicate samples of Grade "A" seed cotton. A difference, significant at approximately the stated probability, is obtained by converting the significant difference calculated for seed cotton, using the mean ginning percentage for all strains in the particular trial.

Details of Trials	A	B	C	D	E	F
Planting dates	4.12.56 ...	4.12.56 ...	4.12.56 ...	22.12.56 ...	6-7.12.56 ...	11.12.56
Plot sizes	5′×30′ ...	5′×30′ ...	5′×30′ ...	5×30′ ...	10′×12′6″ ...	5′×7′6″

Spacing (all trials)—2 rows per 5′ ridge at 18″, thinned to 2 plants per hole.

Seed Treatment.

Testing of various new copper and mercurial formulations continued. In addition, large scale tests were carried out in one of the Booth Drums.

Whilst scores of cotyledon lesions consistently demonstrated the superiority of mercurial over copper dressings at the same rate of application, the results of one trial showed that Perecot applied at rates of 1:100 and 1:200 parts by weight was comparable with Agrosan GN5 applied at 1:300. Details are shown in Table X.

In view of these results a recommendation was made that the rate for seed treatment with Perecot in the Province generally be increased from 8 to 9 lb. per ton (giving a rate of approximately 1:250). This policy will be further reviewed early in the coming season when the results of additional trials become available.

TABLE IX

STEM INOCULATION TRIAL

Strain	Percentage Distribution of Lesion Grades						Resistant Plants (Grade 0 + 1)		Mean Grade
	0	1	2	3	4	5	%	log (x + 2)	
Local	2·6	8·9	45·5	35·1	7·3	0·5	11·5	1·103	2·39
MZ. 561 ...	3·6	19·5	47·9	28·4	0·6	—	23·1	1·396	2·02
UK. 46	2·7	7·5	39·8	39·2	10·2	0·5	10·2	1·011	2·48
UK. 48	5·3	14·8	54·0	25·9	—	—	20·1	1·326	2·01
UK. 51	7·4	16·6	47·2	25·2	3·7	—	24·0	1·341	2·00
UK. 55	32·5	31·9	33·1	2·5	—	—	64·4	1·820	1·03
Albar 49	50·0	47·2	2·8	—	—	—	97·2	1·997	0·51
Least Sign. Diff. (P=0·05) ...	—	—	—	—	—	—	—	0·276	0·35

TABLE X

RATE OF APPLICATION OF PERECOT

Scores of cotyledon lesions at 28 days after planting

Treatment	Percentage Infected	Range	Percentage Vascular infection	Range
Agrosan GN5 1:300w/w ...	4·6	0-10·8	1·0	0- 2·5
Perecot 1:100w/w	3·5	1·5- 6·0	1·3	0- 2·3
1:200w/w	4·9	1·9- 9·2	1·2	0- 2·1
1:300w/w	13·6	5·6-17·6	5·3	0- 9·2
1:400w/w	17·4	12·3-28·4	6·8	1·1-18·2

Two yield trials, similar in design to last year's trial, were laid down—one on rotated land (A) and the other on non-rotated land (B). Trial "B" was adversely affected by drought at the time of emergence and as a result stands were bad and serious bacterial blight did not develop. In Trial "A", 90·8 per cent of the seedings in the untreated plots showed cotyledon infection compared with 17·5 per cent for Perecot treatment and 2·8 per cent for treatment with Agrosan GN5 (both applied at 1:300 parts by weight). In spite of these big differences in the incidence of primary infection related yield differences were not recorded, the yields being 914 lb. acre for untreated, 893 lb. acre for Perecot treatment and 900 lb. acre for treatment with Agrosan GN5—all measured as seed cotton.

Both these trials (and last season's trial) were planted with UK. 51. In previous trials, when substantial increases in yield, associated with seed treatment, were recorded UK. 46 was used, and it can be seen from Table IX that UK. 46 is more susceptible than UK. 51. Although other factors, particularly climatic factors, must also be involved, it seems possible

that the degree of resistance in UK. 51, even though comparatively small, may have played a part in the failure of the heavy primary attack recorded in Trial "A" this year (and in one trial last year) to have caused heavy reduction in crop.

The design of these trials largely precludes the possibility of measuring the effect of seed treatment on the build up of secondary infection, since there is almost certainly spread of infection from untreated to treated plots during the growing season. Next season an attempt will be made to study this problem using a trial layout which has been successfully employed by Wickens at Namulonge, in which a resistant variety is used as a yield indicator on treated and untreated sites, which are widely separated.

Wilt (*Fusarium oxysporum f. vasinfectum*).

As a result of a survey carried out by officers of the Department of Agriculture, *Fusarium* wilt was discovered in several new localities, including three localities on Kome Island where UK. 55 was being multiplied. In view of the possible risk of spread of the disease by seed-borne infection, seed from the whole area was withdrawn from the multiplication programme.

All confirmed outbreaks of the disease, other than those on Kome Island, were confined to the coastal belt in Geita District.

Plants showing symptons of vascular wilt were again found at Lubaga, but attempts to detect the presence of wilt fungus failed.

A. G. Whitehead of E.A.A.F.R.O. visited an infested area in Geita District during April in order to investigate the possibility of nematode attack being associated with the disease. He also visited Lubaga. Whilst he was unable to detect the presence of significant nematode populations in the one locality he visited in Geita District, at Lubaga he discovered root-lesion nematodes (*Pratylenchus*) and spiral nematodes which he provisionally identified as belonging to the genera *Rotylenchus* and *Rotylenchulus*.

Subsequently nematodes were discovered in root swellings on infected plants from Kome Island, but these have not yet been identified.

M. H. Arnold

Reference:

Arnold, M. H.—"Resistance to Bacterial Blight (Xanthomonas malvacearum) in Lake Province 'Local' Cotton"—paper presented to the West African Cotton Research Conference, Samaru—Northern Nigeria—November, 1957.

APPENDIX I

Origin and Special Characteristics of the Main Cotton Strains Mentioned

Lake Province Local	The commercial cotton in the Province prior to the issue of MZ. 561.
MZ. 561	A straight selection from Local, first multiplied in the 1939-40 season.
UK. 46	A seed issue with fair jassid resistance, made up of the best four Ukiriguru strains and the best three Lubaga strains available at the time, first multiplied in the 1946-47 season.
UK. 48	A seed issue made up of four strains of better jassid resistance than UK. 46, first multiplied in the 1948-49 season.
UK. 51	A seed issue made up of seven strains with jassid resistance, first multiplied in the 1951-52 season.
UK. 55	A seed issue made up of 0/334 and 1/667, both ex 8/290, first multiplied in the 1955-56 season.
8/290	Ex 6/320, one of the heaviest cropping Ukiriguru strains, ex 4/35.
0/95	Ex 5/57 ex 3/17.
0/308	Ex 6/318 ex 4/35.
0/328, 0/334, 1/667	Ex 8/290.
1/686	Ex Barberton U4 × Sea Island.
Albar	Nigerian Allen (—Al) blackarm resistance (—bar) selections made at Namulonge. Two series of selections were made independently, Albar 49 in 1949, and Albar 51 in 1951.
Bar 14/38	B_2B_6m Sakel ex Shambat.

SORGHUM BREEDING

General.

The season was a satisfactory one on the whole, although the mbuga lands were waterlogged at times and this affected the yields of the early planted late-maturing varieties. Overcast weather in January with a big American Boll-worm population resulted in much reduced grain production on the bagged heads of the early planted early maturing material in the nursery. The A.B.W. population did not give rise to the expected heavy attack on the cotton, but the second sorghum planting (in early February) was heavily infested in April-May. This infestation might have gone on to the cotton had the sorghum not been there.

The main objectives of the sorghum breeding programme may be summarised as follows:—

(1) The development of better yielding, early maturing varieties with high quality weevil resistant grain.

(2) The development of bird resistant varieties.

(3) The production of tetraploid varieties.

(4) The selection of *Striga* resistant lines.

(1) *Earliness of maturity with high quality, weevil resistant grains.*—The BC2 Wiru line 42B is proving a better cropper than SUK 1, but it is not threshing as cleanly as desirable, some 30 per cent of grain being difficult to clean. Fresh selections were taken this year to try to develop a free-threshing type. Some of these threshed at 95 per cent clean grain.

Yields at two district plots were as follows:—

	Lubaga	Butulwa
Bukura Mahemba	730	1,150
Dobbs...	1,730	... (Bad germination)
B.C. 27	1,660	1,180
SUK 1	1,180	1,040
B.C. 2W 42B	1,560	1,970
L.S.D. (P= 0·05)	285	405

When the figures for the past two seasons are compared, 42B shows up as decidedly better in yield than SUK 1, and the appearance in the field is attractive. It will not be distributed until the threshing is regarded as satisfactory.

Some good lines have appeared in the B.C. 27 (2) × Msumbiji backcross, with excellent grains and satisfactory head size, but they are somewhat later in maturing than is desirable. The best of these lines have been crossed to SUK 1, and to 42 B. It is hoped to obtain earlier strains with good yield from the SUK 1 cross, and the very free threshing of the B.C. 2 MS lines should be an advantage in the 42 B cross.

A large number of reselections were taken from the Dobbs (2) × Wiru backcross, and an attempt is being made to evaluate their resistance to striga. Many have good grains on good panicles.

The B.C. 27 (2) × Belko lines did not show up so well this year, the corneous layer in the grain being good, but the endosperm not completely corneous. Further reselections were made.

Some of the best lines were retained from the cross Oklahoma 44/14 × Kahili, and from Ng'holongo (2) × B.C. 27, the latter for crossing again to Ng'holongo.

Intercrossing of early maturing lines of different origins, mentioned in the last report, has continued. The best material is coming from crosses of B.C. 2W 42B × (Oklahoma × Kahili), B.C. 2W 36D × (Oklahoma × Kahili) and intercrosses of these two. Some look very promising. The other intercrosses have given a decidedly lower standard of grain in the F_2 than had been expected, but 55 selections of the requisite standard were taken out of large F_2 bulks.

The F_1 of the backcross Dobbs × (Dobbs × Wiru Ugogo) was grown out. Wiru Ugogo has a grain resembling that of Msumbiji.

(2) *Bird Resistance.*—The best lines with goose-neck and good grain have come from the cross 55 × 37, the goose-neck being of Korgi origin. There were some good plants and grains in the 55 × 47 cross, but the goose-neck seems less consistent. It originated from Ng'holongo.

The 1954 crosses (54 ×) yielded some panicles with satisfactory glume cover, and excellent grains, but the plants were rather tall, and yield would be rather low, judging from this year's progeny rows.

Only a few selections from the 55 × crosses were retained—those with goose-neck and good grain. Seven selections with large glumes, and grains in the pedicelled spikelets as well as the sessile spikelets were kept, as it will be of interest to see whether the extra grains would be a character of practical value.

The 56 × crosses yielded some very satisfactory plants with good grains and good glume cover, and some goose-necks, but very few had the combination of these characters. One hundred and twenty selections were kept.

The stage has now been reached where several generations of progeny row breeding are required before further hybridisation is undertaken. The 53 × crosses have yielded goose-neck with good grain: the 54 × crosses, good glume and good grain. They will be maintained in case further crossing is necessary. The 56 × crosses show signs of yielding good glume and good grain with satisfactory plant type, but it may be difficult to obtain these characters in combination with goose-necked heads. Goose-neck is a very awkward character to work with as weather conditions at the time of panicle emergence seem to influence its expression. From the 56 × crosses lines, it will be possible to assess whether good glumes give sufficient protection against birds by themselves. If this does not prove to be the case it may be necessary to intercross some of the lines, or to cross with the 53 × 37. At a later stage, crosses will be made between the 56 × lines, and the B.C. 2 Msumbiji, to get the Msumbiji grain type and free threshing character.

Selection has continued in B.C. 2 Belko and the Mandayel Poona crosses for a better awn, but nothing really good enough has appeared.

The wild grass *Sorghum purpureo-sericeum* has very good awns indeed, and this season the chromosome number was doubled with colchicine, and the resultant plants crossed to both diploid and tetraploid grain sorghums. It is not yet certain that the cross has succeeded, and it may well prove a very difficult one to make. The *S. purpureo-sericeum* may have high striga resistance so that it will be fully justifiable to spend some time in attempting to effect the cross.

(3) *Tetraploids.*—The F_3 progeny rows of the 4N × 5 crosses (see last year's Report) were grown out. Conditions at flowering were unfavourable, overcast weather and high humidity resulted in moulds on the heads inside the selfing bags, and there was a very high population of American Bollworm. The mean seed sets of the F_3 rows ranged from 30 per cent to 80 per cent, with a mean of 56 per cent over all rows. This was below the mean set for the F_3 generation, but the unfavourable setting conditions make it uncertain whether this difference is likely to be real. Plants setting over 80 per cent seed were selected, and an F_4 generation grown from them in the greenhouse. Set counts are not yet available, but inspection shows that the set is high, and will be near the diploid level.

Other tetraploid lines were grown, and intercrossed. It is evidently important to know which varieties will give a rapid restoration of seed set when crossed together.

The tetraploid lines from the 53 × 44 cross appeared most promising, with vigorous plants and good heads. This is a triple grain line, and was doubtless affected by the bad setting conditions. Forty-seven per cent of the spikelets set seed, but the apparent fertility (number of grains to total sessile spikelets) was 70 per cent.

There is every reason to be confident that good tetraploid lines with a high seed set can be produced quite easily by intercrossing and selection, and if necessary the use of twin or triple types should ensure a high apparent fertility in cases where the absolute fertility is somewhat low.

Cytological studies indicated that the increased fertility resulting from intercrossing of autotetraploid lines is associated with an increase in the number of bivalents. A paper on tetraploid work will be published shortly.

(4) *Striga resistance.*—Various methods of estimating *striga* resistance have been investigated. Variety trials on a field infested with *Striga hermonthica*, and on a field infested with *Striga asiatica*, have been carried out to obtain an estimate of resistance by counting the striga plants which develop.

Striga counts on the district plot trials were as follows:—

	Striga plants per acre		
	Lubaga	Mwanangwa	Butulwa
Bukura Mahemba	144,040	10,440(a)	3,350(a)
Dobbs	4,700	3,700	175
B.C. 27	18,700	10,010	520
SUK 1	60,560	13,180	510
B.C. 2W 42B	32,370	12,120	815

(a) Not strictly comparable. The Dobbs plots were refilled.

Striga levels were high at Lubaga, and there 42B seems slightly better than SUK 1, but inferior to Dobbs. The Mwanangwa figures do not show any noteworthy differences: striga distribution there was patchy. The level of striga at Butulwa was too low for differences to be reliable.

Details of the striga rotation trial and the yields were given in last year's report. The following yields were obtained from the plots under sorghum this season:

Treatment	Yield in lb./acre grain
1. Continuous Bukura Mahemba, no striga pulled	130
2. Continuous Dobbs, no striga pulled	310
3. Continuous Bukura Mahemba, striga pulled every 14 days	335
4. Continuous Bukura Mahemba, striga pulled every 28 days	370
5. Continuous Bukura Mahemba, striga pulled every 42 days	95
13. One year Bukura, 2 years Dobbs, Dobbs 1956-57 season	375

The remaining treatments were under other crops, or fallow. Next season, all treatments will be sown with Bukura Mahemba. It remains to be seen whether the 5 year tumbledown fallow, or the 5 year cropping with cotton and millet will have had any effect. It is certain that the shorter rotations are valueless in reducing the incidence of *striga*.

1957 yields from the old striga trial are as follows:—

	Striga pulled	Striga not pulled
Dobbs	825	560
Bukura Mahemba	450	195

This year, the Dobbs yield was affected by the striga, although most of the yield difference is contributed by one replication.

The 13 striga resistant selections from Dobbs which were planted as bulks this year, showed counts of from 1·6 to 5·3 striga per plant early in the season, with a mean of 3·9. Later counts of flowering striga showed a range of from 0·6 to 3·9 striga per plant, with a mean of 2·7. The corresponding figures for bulk Dobbs were 4·8 to 6·1, mean 5·6, and 1·9 to 3·6, mean 2·7. The five best selections will be tested next year.

It seems fairly clear that the breeding of resistant varieties, using initially Dobbs as the source of resistance, and the pulling of striga plants which come above ground, are the best methods of combatting this parasite under local conditions. Resistant varieties should result in a reduction in the number of striga plants to a level that the cultivator will be able to handle by pulling or hoeing.

H. Doggett,
Botanist

MWANHALA RESEARCH STATION

Rainfall

October	0·12	March	3·64
November	2·43	April	7·93
December	5·44	May	1·91
January	5·36	June	0·39
February	2·40	Total ...	29·62

The total amount and distribution of rainfall can be regarded as reasonably favourable. In December and January the rainfall was about the average, for February and March it was below average and in April well above average.

Fertiliser and Manurial Trials.—Previous work at Mwanhala on fertilisers and manure used food crops, maize, sorghum and millets as indicator crops. A series of experiments has now been started using cash crops. Whether these experiments will become permanent or not depends on the results over the first few years.

Three experiments of the following design (3 × 2 × 2) were planted:—

Nil.	Nil	Nil
3 tons shed manure spread before ridging	130 lb. double superphosphate	130 lb. sulphate of ammonia.
3 tons shed manure under ridge.		

Sulphate of ammonia was not applied to legumes.

TABLE I

Soya bean, Yield in lb. per acre

Soil Type, Red Kikungu

Superphosphate	Manure			
	Nil	Spread	Placed	Means
Nil	397	456	548	467
Present...	640	697	734	690
Means	519	577	641	

Significant Differences	Mean Manures	Mean Phosphate	Body of Table
5 per cent ...	93 ...	76 ...	132
1 per cent ...	121 ...	99 ...	171

Phosphate gave appreciable and highly significant increases in yield. Both methods of applying manure increased yields. There was no significant difference between methods and only manure placed under the ridge was significantly better than no manure in the absence of phosphate.

Although the experiment was sited on land that had not been cultivated for at least seven years, a severe infestation of *Alectra* occurred, particularly on three blocks. Average treatment yields from the least affected blocks were about 300 lb. per acre higher than the figures given above.

TABLE II

SESAME, YIELD IN LB. PER ACRE

Treatment	Yield	Least Sig. Differences	
		P=0·05	P=0·01
No nitrogen	620	58	77
130 lb./acre S/A	732		
No Phosphate	547	58	77
130 lb./acre double supers	805		
No Manure	601		
Manure before ridging	704	71	94
Manure placed under ridges	722		

Both fertilisers and manures gave highly significant and appreciable increases in yield. Phosphate gave by far the greatest response, those given by nitrogen and manure were approximately the same. Interactions were not significant.

TABLE III

CASTOR BEAN, YIELD IN LB. PER ACRE

Soil Type, Red Kikungu

Superphosphate	MANURE			
	Nil	Spread	Placed	Means
Nil	165	268	314	250
Present	344	441	332	372
Means	255	355	323	—

Significant Differences	Mean Manures	Mean Phosphate	Body of Table
5 per cent ...	64 ...	52 ...	90
1 per cent ...	84 ...	69 ...	119

Nitrogen had no effect on yield. Both phosphate and manure gave appreciable and highly significant responses. There was a significant negative interaction between phosphate and placed manure.

The yields were disappointingly low. A giant type was planted at 5 feet by 5 feet spacing and this appeared to be too great. Insect damage was moderately severe. The results however do show that a great deal of further work on the manurial requirements of this crop is necessary in most areas.

In the groundnut trial an extra rate of phosphate application was included.

TABLE IV

GROUNDNUTS, LB. OF KERNELS PER ACRE

Superphosphate	MANURE			
	Nil	Spread	Placed	Means
Nil	758	970	887	872
100 lb.	1,041	1,111	1,099	1,084
200 lb.	1,155	1,265	1,267	1,229
Means	985	1,115	1,084	

Significant Differences	Means	Body of Table
5 per cent	43 ...	75
1 per cent	59 ...	102

Both phosphate and dung gave highly significantly increased yields but the increases were much greater for phosphate than for dung. There was a just significant negative interaction between dung and phosphate.

In a factorial 2 × 2 × 2 experiment on rice the following treatments were tested.

100 lb. per acre double superphosphate.

100 lb. per acre sulphate of ammonia in two applications.

3 tons per acre shed manure.

TABLE V

RICE—LB. PADDY/ACRE

Treatment	Yield	
No sulphate of ammonia	1,514	Least Sig. Diff.
100 lb./acre S/A	1,707 ...	P=0·05 154
No phosphate	1,448 ...	P=0·01 210
100 lb./acre double super	1,768	
No manure	1,403	
Manure at 100 lb./acre	1,813	

Nitrogen gave the lowest response and manure the highest. The responses to phosphate and manure were highly significant. There was also a significant negative interaction between phosphate and manure.

In a fallow experiment begun this year fertiliser treatments are included and the results are given below.

TABLE VI

MAIZE LB. PER ACRE

Groundnuts lb. of kernels per acre

	Maize	Groundnuts
Nil	1,566 ...	872
3 tons manure per acre	1,958 ...	1,039
120 lb. double superphosphate	2,390 ...	1,112
Significant Differences:		
5 per cent	276 ...	116
1 per cent	379 ...	159

(Maize also received 120 lb. of sulphate of ammonia in addition to the superphosphate).

Both treatments gave highly significant and appreciable responses.

Conservation of Rainfall.—A study of the reliability of the rainfall has shown that whilst the average totals for December, January, March and April, 6·0, 5·7, 5·2, 5·4, are reasonable the reliability is poor. On the other hand the average for February, 3·9, is significantly lower but more reliable.

It was thought that if a proportion of the rain that fell during December and January could be conserved until February the crop might get a better start in this month of more uniform rainfall. A simple experiment was designed to check this possibility. Maize and groundnuts were planted at the beginning of December, January and end of January in the ordinary way, the land being cultivated just before planting. One further set of plots however was kept clean weeded during December and January and another set during January only. Both these sets were planted at the end of January. Nitrogen and/or phosphate were applied as appropriate.

TABLE VII

EFFECT OF PREVIOUS TREATMENT OF LAND ON YIELDS OF MAIZE, LB. PER ACRE, AND GROUNDNUTS, LB. KERNELS PER ACRE

Condition of Land			Yields		Rainfall
Dec.	Jan.	Feb.	Groundnuts	Maize	in
Crop ...	Crop ...	Crop ...	1,647	1,873	23·4
Dirty ...	Crop ...	Crop ...	1,639	2,070	20·6
Dirty ...	Dirty ...	Crop ...	1,134	1,350	17·4
Clean ...	Clean ...	Crop ...	1,377	1,508	17·4
Dirty ...	Clean ...	Crop ...	1,323	1,544	17·4

Significant Differences	Groundnuts	Maize
5 per cent	159 ...	220
1 per cent	216 ...	300

There were large and highly significant decreases in yield for the late January plantings compared with the early December and early January plantings for both crops. There were also differences between the yields of the three late planting treatments. The yield was appreciably less when the land had remained dirty for the period previous to sowing. The differences were only significant in the case of groundnuts.

The rainfall figures given in Table VII are the total amounts falling from the week in which the crop was planted to the week before harvesting. The total was adequate for the December and early January plantings but perhaps marginal for the late January planting Very severe water-strain, judged by the non-occurrence of wilting at 2 p.m. did not occur.

Keeping the land dirty for two months before planting caused a loss in yield of about 200 lb. per acre of both crops in spite of the generally favourable rainy season. February had a rather low rainfall and it is possible that water stored in the soil profile under bare soil resulted in the higher yield. It is not considered that any immobilisation of nitrogen consequent on ploughing in weeds was the cause of the lower yield of maize when the land had remained weedy for 2 months. Some nitrogen would have been leached from the clean plots but 130 lb. of sulphate of ammonia was top dressed on the maize when it was 6-9 inches high.

Intercropping.—Two experiments were carried out to test the value of intercropping groundnuts with maize or sorghum. Widely differing plant populations of each crop and pure stands at similar populations were compared.

The following plant populations were planted in thousands per acre.

	Trial I		Trial II	
	Groundnuts	Maize	Sorghum	Groundnuts
High (H) ...	44·8 ...	11·2 ...	33·6 ...	33·6
Medium (M) ...	33·6 ...	7·5 ...	16·8 ...	22·4
Low (L) ...	22·4 ...	3·7 ...	11·2 ...	16·8

In each trial all combinations of the populations of each crop given above were planted, together with pure stand. The results of the direct competitive effects of one crop on the other will not be described here, but a comparison of the yields from one acre of intercrop and from two half acres of pure stands is given in Tables VIII and IX.

TABLE VIII

Comparison of Yields from one acre of intercropping and two half acres of pure stands, lb.

Maize and Groundnuts

Population Level		Intercrop		Pure stands	
Maize	Groundnuts	Maize	Groundnuts	Maize	Groundnuts
L ...	L ...	920	820	—	616
L ...	M ...	886	868	703	690
L ...	H ...	954	798	—	670
M ...	L ...	1,416	572	—	616
M ...	M ...	1,002	732	995	690
M ...	H ...	840	640	—	670
H ...	L ...	1,196	516	—	616
H ...	M ...	722	552	834	690
H ...	H ...	722	594	—	670

At the low maize population there is a clear gain in intercrop yield for both maize and groundnuts at all groundnut populations. At the medium maize population intercropping gives a large increase in maize yield at the low groundnut population and a slight loss at the

high groundnut population, there are also slight but not significant losses in yields of groundnuts. At the high maize population there is a general reduction in yield of both maize and groundnuts except for maize at the low groundnut population.

Taking the yields of maize and groundnuts at the medium populations as the best in pure stands, there is clearly no overall loss in yield by intercropping a low maize population with groundnuts. This combination would probably give the highest financial return per acre.

TABLE IX

COMPARISON OF YIELDS FROM ONE ACRE OF INTERCROPPING AND TWO HALF ACRES OF PURE STANDS, LB.

Sorghum and Groundnuts

Population Level		Intercrop		Pure stands	
Sorghum	Groundnuts	Sorghum	Groundnuts	Sorghum	Groundnuts
L	L ...	370	837	—	—
L	M ...	222	1,175	323	783
L	H ...	391	1,004	—	—
M	L ...	431	946	—	—
M	M ...	471	1,012	323	783
M	H ...	438	1,137	—	—
H	L ...	761	783	—	—
H	M ...	471	764	323	783
H	H ...	451	869	—	—

Differences in yield were not significant for the three populations of both crops in pure stand and only the mean yields are given as standards.

Sorghum midge caused serious damage and materially reduced yields of sorghum.

Intercropping was clearly greatly superior to pure stand cultivation. Only sorghum at the low population in the presence of a medium population of groundnuts yielded less than the standard. The "insurance" value of intercropping is markedly shown by these results.

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TABLE I

RAINFALL

Month	1957		Average for 6 years	
	Days	Inches	Days	Inches
January	15	5·37	13	6·03
February	8	4·15	8	5·06
March	23	8·66	19	7·29
April	21	15·51	21	15·06
May	21	15·00	18	9·87
June	5	1·69	5	1·88
July	5	2·78	6	1·76
August	9	5·87	8	2·18
September	8	3·81	8	3·53
October	13	5·37	13	4·89
November	22	8·96	22	7·32
December	19	4·60	15	5·13
Total	169	81·77	156	70·99

Rainfall during 1957 was considerably above average, especially during the long rains from March to May.

Robusta Coffee.

(a) *Improvement of Planting Material.*—Fifty outstandingly good trees in the district were selected as clone mother trees to provide clonal material for selection trials. Cuttings were taken in April, and placed in a propagator. Unfortunately only about 25 per cent of cuttings rooted, and many more died after potting up. In Uganda, about 75 per cent of cuttings are normally found to be well rooted after six weeks in the propagator. It is thought that the poor results at Maruku may have been partly due to the use of the wrong type of vermiculite as rooting medium.

The trees in the Coffee Selection Trial, on "Rweya" grassland soil have continued to make good growth. In their first bearing season (1956-1957) an average yield of ½ lb. clean coffee per tree was obtained, equivalent to 140 lb. per acre. In the 1957-58 season, the trees have so far given an average of 1½ lb. clean coffee per tree, or 450 lb. per acre. Individual trees have yielded up to 7 lb. of clean coffee. At the time of writing about 20 per cent of the crop is still to be picked. Material from the better trees will be used in clone trials.

(b) *Cultural Trials.*—A factorial trial was laid down in November, 1956, to study the effects of farmyard manure, lime and an inorganic fertiliser mixture on the growth of coffee seedlings. Farmyard manure was applied in the planting holes and the lime and fertiliser were worked into the top soil round the seedlings.

The results are shown in Table II.

Lime has so far had no effect on growth rate. Inorganic fertiliser applied at planting has also given no response. There was a slight increase in growth rate when extra fertiliser was given as top dressing, but the increase was not significant. Farmyard manure has given substantial increases in growth.

TABLE II

AVERAGE GROWTH PER SEEDLING IN INCHES FROM NOVEMBER, 1956 TO NOVEMBER, 1957

	No farmyard manure	Farmyard manure 21 lb. per planting hole	Farmyard manure 42 lb. per planting hole	Mean
F0	13·0	13·5	18·1	14·9
F1	11·0	15·9	18·1	15·0
F2	13·2	18·0	19·8	17·0
Mean	12·4	15·8	18·7	15·6

Least Significant Differences for means:—

5% ... 2·29
1% ... 3·13

F0 ... = ... no inorganic fertiliser.

F1 ... = ... 2 cwt./acre sulphate of ammonia.
2 cwt./acre double superphosphate.
1 cwt./acre muriate of potash, applied at planting.

F2 ... = ... As F1, plus an equal quantity of the same mixture applied during the year as top dressing. Three applications of top dressing, each of one third the above quantities were actually made.

A study of the root growth of Robusta coffee showed that, under conditions at Maruku, the average depth of tap root penetration of seedlings after six months and twelve months was 18 inches and 33 inches respectively. Lateral root growth after these times was 15 inches and 32 inches. Where compost was placed in the planting hole lateral roots occurred frequently to a depth of two feet. In the absence of compost, lateral roots were confined to the top foot of soil.

A coffee and banana interplanting trial was laid down during the year. A study is to be made of the effect of bananas planted at various densities.

Coffee seedlings have been planted in readiness for a new factorial trial on the effects of cultivation, mulching, interplanting, and nitrogenous manuring.

Seedlings were also established for a pruning trial. Various pruning and training methods will be used on the erect type of robusta coffee, and on the "Nganda" or spreading type.

Trials are also being carried out on methods of seed storage, and the low germination percentages commonly experienced in district nurseries. Removal of the parchment before sowing appears to increase the speed of germination.

(c) *Stephanoderes control trials.*—The trials carried out in collaboration with the Coffee Entomologist, Lyamungu were continued. As in previous years Endrin spraying has greatly reduced Stephanoderes damage. Endrin has also significantly reduced the damage caused by Coffee Berry Moth. As reported elsewhere (Entomology, Lyamungu), a large scale trial has been started to investigate the effect of Endrin applied to a complete village area isolated from other coffee. A pest assessment trial was started in August, to estimate the effect of Stephanoderes control by Endrin in increasing yield and improving quality.

Arabica Coffee.

Seedlings of improved selections of Arabica coffee have been planted out in variety trials at Maruku, Kituntu and Nyamiaga (Ngara). The improved types comprise Bourbon selections from Kenya and Lyamungu, and Kents selections from Lyamungu. Observation plots of these varieties have also been planted at Ruganzo (Ngara) and Kawalinda Estate (Bukoba).

A pruning and training trial has been planted at Kituntu.

An anti leaf fall spray trial, using a 2 per cent copper spray as recommended in Kenya, was laid down at Kawalinda Estate in May, 1957. No reduction of leaf fall during the following dry season was observed.

Bananas.—The Banana Establishment Trial (1951) is being maintained as a demonstration. Only bananas which have received a complete fertiliser dressing are growing well.

Tea.—Part of an abandoned tea garden has been cleared, and a few bushes have been pruned. They will be plucked to give an indication of the productive potential of the area.

In June, 1956, tea nurseries were established, using seed from Tukuyu, and some 2,400 stumps were planted out in November, 1957. A Tea Establishment Trial has been laid down, investigating the effects of compost, urea, superphosphate, muriate of potash, and sulphur on young tea.

Soil Fertility Investigations.

(a) *Trial on improvement of "Rweya" land by deep rooted legumes and grasses.*—Plots of elephant grass, tropical Kudzu, *Dolichos argenteus* (Yogwe-yogwe), and Pigeon Pea were planted in November, 1956, with and without fertiliser. After periods of 2, 4, and 6 years these plots will be ploughed and a test crop of maize taken.

The Elephant Grass and Pigeon Pea have grown well, but Dolichos and Kudzu have not yet given an adequate ground cover.

(b) *Trial on improvement of "Rweya" land by application of manure.*—A Factorial trial was carried out on maize involving the application of farmyard manure, lime, and various combinations of nitrogen, phosphate, and potash. The crop was very poor mainly because of excessive rain, stalk borer damage, and thefts. For this reason dry weights of maize plants were taken instead of grain yields.

WEIGHTS OF MAIZE PLANTS LB. DRY MATTER/ACRE

	No farmyard manure	5 tons/acre farmyard manure	10 tons/acre farmyard manure	Mean
NPKL	3,280	4,200	6,200	4,560
PKL	1,640	1,600	2,880	2,040
NKL	600	1,760	5,760	4,360
NPL	1,720	4,160	5,840	3,904
NPK	1,880	3,840	4,280	3,332
Nil	240	1,160	2,000	1,132
Mean	1,892	3,528	4,508	3,224

Least significant difference, Farmyard manure means.

5% ...	1,404
1% ...	1,932

Least significant difference, inorganic fertiliser treatment means.

5% ...	1,988
1% ...	2,720

Treatments: N. 2 cwt./acre sulphate of ammonia.
P. 2 cwt./acre double superphosphate.
K. 1 cwt./acre muriate of potash.
L. 20 cwt./acre ground limestone.

Farmyard manure significantly increased the yield of dry matter per acre. The fertiliser treatments including nitrogen in the presence of manure gave significantly higher dry matter yields than where nitrogen was omitted.

The trial was replanted with maize in September, 1957, to assess the residual effects, if any, of the phosphate, potash, lime and farmyard manure. A further application of nitrogen as a top dressing was made to those plots which had previously received sulphate of ammonia.

(c) *"Rweya" grassland manurial trial.*—Four non-replicated experiments were laid down in November, 1956, to investigate the effects on grass yield of nitrogen, phosphate, muriate of potash, lime and frequency of cutting.

Sulphate of ammonia gave a considerable increase in dry matter production per acre. Potash appears to have given a small response. Phosphate and lime had no obvious effect. In all cases the total production of dry matter was greatest when the plots were cut only twice per year.

(d) *Nutrient deficiency investigation on coffee and bananas.*—In collaboration with the Government Chemist, trials of foliar sprays containing trace elements were carried out on coffee and bananas. No obvious results have followed the application of minor nutrient elements.

The injection of calcium borate into banana suckers has similarly produced no result.

H. W. MITCHELL,
Agricultural Officer

GENERAL EXPERIMENTAL WORK, LAKE PROVINCE

Cotton Insecticide Trials.

A series of demonstration plots was laid down at various sites in the main Lake Province cotton areas. Unsprayed cotton was compared with cotton which had received the standard insecticidal treatment recommended, i.e. four applications of 1 lb. D.D.T. per acre followed by four weekly treatments of 1 lb./acre D.D.T. and ¼ lb./acre B.H.C.

The anticipated outbreak of cotton pests, and in particular American Bollworm, did not materialise in the main cotton growing areas, but in North Musoma and North Mara Districts insect attack was heavy and from these areas were obtained the most striking results of the trials. The cost of the spraying, was, however, too high (over Shs. 180/- per acre) for it to be an attractive proposition to the African cotton grower. Further trials and observations are being planned paying particular attention to the eventual cost of spraying by the farmer, which to be attractive must be below Shs. 100/- per acre.

Spraying commenced during March and continued into May. Of the 31 plots sited a number had to be abandoned for trial purposes due to the owner failing to weed in time, theft of cotton harvested, and so on.

The mean yield from undusted cotton was 443 lb. of seed cotton per acre. The mean response from insecticidal treatment was 332 lb. (± 132 lb. at the 1 per cent fiducial limit) a very valuable and appreciable response.

Manurial and fertiliser trials.

At Ukerewe manuring and fertiliser trials on cotton showed a marked response to FYM at 5 tons/acre. Only a small response to 200 lb./acre double superphosphate or 200 lb./acre sulphate of ammonia was obtained. The nitrogen was not applied until May which was probably too late.

A fertiliser trial on Ukara Island (100 lb./acre of double superphosphate with and without 100 lb./acre sulphate of ammonia) gave increases of 49 per cent and 54 per cent yield of bulrush millet respectively.

M. Lunan,
Assistant Director of Agriculture, Lake Province

REGIONAL RESEARCH CENTRE, NACHINGWEA—PLANT BREEDING

TABLE I

RAINFALL, EXPERIMENTAL FARM, NACHINGWEA, 1956-57

		Inches	Days	Average for 8 years, Inches
1956	December	1·99	10	3·85
1957	January...	7·16	14	6·71
	February	7·31	13	7·82
	March	5·89	16	6·14
	April	7·83	16	6·03
	May	1·23	6	1·30

Effective rains began in late December, 1956, and continued until early May, 1957. The rainfall was well distributed and there was no marked drought. It was a good season for all crops.

SOYA BEANS

1.—General.

Table II gives a summary of yield and other characteristics of varieties which were grown in large bulks on 28 inch rows with 2 inch spacing between plants.

TABLE II.—CHARACTERISTICS OF SOYA BEAN VARIETIES

Variety	Source	Yield lb./acre	Habit	Days to Maturity	Seed colour
Malaya	Nigeria	1,996	Indeterminate	121	Yellow
Hernon 237	S. Rhodesia ...	1,990	Indeterminate	121	Yellow
Light Speckled... ...		1,725	Determinate	107	Yellow
S 3	B. Congo	1,561	Determinate	107	Yellow
R 184		1,555	Determinate	107	Yellow
MIS 28EB	Phillipines... ...	1,532	Indeterminate	118	Yellow
CNS	U.S.A.	1,476	Intermediate	115	Brown
Benares	Nigeria	1,391	Indeterminate	121	Yellow
Glycine Rugget ...		1,329	Determinate	107	Black
Soya 27...	Phillipines... ...	1,295	Determinate	107	Black
S 14	B. Congo	973	Determinate	107	Yellow-Green

Small bulks of the varieties Avoyelles, Soya 16, Soya 29, Toro, Dixie, Venezuela and H29 were also grown, but they were planted rather late in the season and the stands were too poor to get an estimate of yield. None of these varieties appeared very promising however. Toro (ex Uganda) and Venezuela are characterised by a much larger seed than normal.

An analysis of seed of Soya bean varieties was carried out by the Chemist.

TABLE III.—ANALYSIS OF SEED OF SOYA BEAN VARIETIES

Variety	Component as per cent of Seed				Free Acid per cent of oil
	Oil	Moisture	Nitrogen	Crude Protein	
Malaya	18·2	13·3	6·5	40·6	1·2
Hernon 237	18·7	13·8	6·3	39·4	1·0
Light Speckled	17·3	14·0	6·8	42·5	1·3
S 3	16·9	14·3	7·0	43·7	1·1
R 184	17·3	14·3	6·8	42·5	1·5
MIS 28EB	19·0	13·7	6·3	39·4	2·0
CNS	19·7	13·3	6·4	40·0	1·0
Benares	16·2	13·6	6·9	43·1	1·2
Glycine Rugget	19·6	13·4	6·0	37·5	1·2
Soya 27	19·1	13·6	6·0	37·5	1·3
S 14	19·4	14·0	6·2	38·8	1·5
Soya 29	15·4	13·8	6·9	43·1	1·2

There appears to be a rough inverse relation between oil and crude protein.

Table IV summarises the results of a variety and spacing trial.

TABLE IV.—SOYA BEAN SPACING AND VARIETY TRIAL

Yields in lb. per acre

Spacing	Hernon 237	CNS	Light Speckled	Mean
28″ × 2″	1,766	1,351	2,056	1,724
28″ × 4″	1,984	1,662	1,777	1,808
28″ × 8″	2,048	1,508	1,830	1,795
Mean	1,933	1,506	1,887	1,776

Significant Differences	Body of Table	Variety and Spacing Means
5 per cent	293	168
1 per cent	386	218

The Hernon 237 and Light Speckled varieties are superior to CNS, but there is no significant difference between Hernon 237 and Light Speckled. Spacing within 28 inch rows has no appreciable effect on yield.

The interaction table shows a very interesting fact. Hernon, an indeterminate variety, yielded highest when planted at 8 inch spacing, whereas Light Speckled, determinate in habit, recorded the highest yield at close spacing. CNS, a variety with a habit intermediate between the other two varieties, gives the highest yield at 4 inch spacing.

Hernon 237, at present being grown on the production farms of the Tanganyika Agricultural Corporation, is planted on 28 inch ridges with 2 inches between plants in a row. Ideally, it seems that 8 inches between plants in a row would be better. On the other hand, the plants are subjected to the hazards of machine planting, termite damage, etc., in bulk plantings, and it is considered that to obtain an ideal stand, closer spacing than 8 inches is necessary.

2.—Selection.

Fifteen selections from Hernon 237 and four selections from MIS 28EB were put into a 5 × 5 balanced lattice with parental Hernon 237 and parental MIS 28EB. Three selections from Hernon 237 yielded 50 lb. per acre more than the unselected Hernon 237, and one selection from MIS 28EB yielded 100 lb. per acre more than the unselected parent. If these again prove higher yielders in a trial next season, they will be issued to Tanganyika Agricultural Corporation production farms as "Nachingwea Hernon" and "Nachingwea MIS 28EB".

A uniform strain of Hernon 237 would be welcome on the production farms, as the Hernon 237 at present being grown is a mixture of types with regard to maturity and lodging.

Individual plant selections were made from Soya 27, CNS, R 184, Light Speckled Glycine Ruggett, S 14, S 3, Malaya and Benares. Some of the selections from Light Speckled and R 184 look quite promising.

3.—Breeding.

The objects of the breeding work are as follows. Two main types are being sought:—

(a) High yielding, non-shattering, determinate in habit, with pods formed 6 inches above ground level for mechanical harvesting.

(b) High yielding, non-shattering, but with no qualifications as to habit, for hand harvesting by the African farmer. Varieties differing in days to maturity would allow for the staggering of both planting and harvesting.

F3.—Generations.

Table V shows the F3 generation of crosses grown this season and their yields in large bulk plots on 28 inch rows at 2 inch spacing within rows.

TABLE V.—YIELDS OF F3 GENERATION SOYA BEAN CROSSES

Cross	Yield in lb./acre
R 184 × Hernon 237...	1,855
R 184 × Benares	1,835
R 184 × CNS...	1,779
Light Speckled × CNS	1,683
Glycine Ruggett × CNS	1,581
Glycine Ruggett × Benares	1,527
Glycine Ruggett × Malaya...	1,513
Malaya × R 184	1,490
Benares × Light Speckled	1,471
Light Speckled × MIS 28EB	1,372
MIS 28EB × R 184	1,363

Comparisons of these yields with the yields of parent varieties in Table II show that four crosses give higher yields than either of the two parents, three crosses give lower yields than either one or both of the parents, and four give yields intermediate between the two parents. The fact that none of these crosses does give a higher yield than the highest yielding varieties we have at present, is in no way cause for alarm, for previous work has shown that the yield performance of bulk hybrid populations is unreliable in predicting the yield of segregates from Soya bean crosses. These figures, however, may be interesting to compare with the yields of bulk populations of the F4 and F5 generations of these crosses, which will be grown next year to try to obtain an estimate of natural selection within a segregating population.

On the other hand, resistance to lodging within a bulk hybrid population is an indication as to this character in the segregates. On this basis, very little seed from the F3 generation of the cross Glycine Ruggett × CNS will be retained for further selection as the whole cross lodged badly.

F4.—Generations.

By irrigation during the 1956 Dry Season F4 seeds had been obtained from the following crosses.

MIS 28EB × R 184.

Hernon 237 × Light Speckled.

Light Speckled × CNS.

During the 1957 wet season, about 10,000 F4 plants from each of the above crosses were grown at wide spacing (28 inches between rows and 8 inches between plants). From these, individual plant selections were made in the field on the basis of habit, yield, maturity and resistance to lodging. After the most desirable plants had been selected, the remainder were left in the field to test for non-shattering qualities. Two plants from the cross Hernon 237 × Light Speckled were selected as non-shattering.

The chief characters recorded in the laboratory after harvest were height, the height from soil level to first branch, number of pods, number of seeds per plant, total weight of seeds, weight of 100 seeds.

Four hundred and ten selections were retained from MIS 28EB × R 184, 239 from Light Speckled × CNS, and 174 from Hernon 237 × Light Speckled. The best material as far as yield is concerned seems to be coming from MIS 28EB × R 184, but very good plants as far as habit is concerned are coming from Hernon 237 × Light Speckled. The cross Light Speckled × CNS has the disadvantage that it is segregating for seed colour. Material with a wide range of maturity is being obtained.

There seems to be some correlation between the height of the plant and the yield, i.e. the heaviest yielders are the tallest plants.

Seed from these individual plant selections will be grown in progeny rows in the F5 generation next year.

Crossing.

The following crosses were made during the dry season.

Venezuela × Hernon 237.

Toro × Malaya.

Toro × Hernon.

The object of these crosses was to transfer the large seed of Venezuela and Toro on to the high yielding characters of Hernon 237 and Malaya—in the hope that they would be additive on the yield.

C.—Sesame

This is already an important cash crop for the African cultivator in the Southern Province. It could also be an important crop for the Tanganyika Agricultural Corporation, if a non-shattering high yielding variety were available. Two non-shattering varieties from the U.S.A., Rio and Palmetto, were grown, but both gave very disappointing yields. Enough seed of Rio was available for trials with the Local Sesame variety. The results of these trials are shown in Tables VI, VII and VIII.

TABLE VI.—SESAME VARIETY AND TIME OF PLANTING TRIAL 2 × 4 FACTORIAL

Yields in Lb. per Acre

Spacing, 12 inches between plants, 34 inch rows

Varieties	Dates of Planting				
	20.2.57	27.2.57	6.3.57	13.3.57	Mean
Local Sesame	325	262	175	152	228
Rio	34	31	11	9	21
Mean	179	146	93	80	125

Significant Differences	Body of Table	Variety	Planting Date
5 per cent	63	31	45
1 per cent	81	43	60

TABLE VII.—SESAME VARIETY AND SPACING TRIAL 2 × 2 FACTORIAL

Yields in Lb. per Acre

Varieties	Spacing within rows			
	6 inches	12 inches	18 inches	Mean
Local Sesame	390	372	343	368
Rio	31	22	20	24
Mean	210	197	182	196

Significant Differences	Body of Table	Variety	Spacing
5 per cent	69	40	50
1 per cent	90	52	64

Row width was 34 inches

The experiments recorded in Tables VI and VII were planted on upland red sandy loams.

TABLE VIII.—SESAME VARIETY, SPACING AND TIME OF PLANTING TRIAL 2 × 2 × 2 FACTORIAL

Yields in Lb. per Acre

Date of planting	5.3.57		19.3.57		
Spacing	6 inches	12 inches	6 inches	12 inches	Mean
Local Sesame	343	318	170	177	252
Rio	34	25	16	11	22
Mean	188	172	93	94	137

Mean: Dates	5.3.57	180	19.3.57	93
Mean: Spacing	6 inches	140	12 inches	133
Mean: Varieties	Local	252	Rio	22

Significant Differences	5 per cent	1 per cent
Varieties, Spacing and Dates	47	65
Body of Table	90	119

This experiment was planted on Nkumba black loam, a valley soil. Row width was 34 inches.

The local shattering variety is undoubtedly superior to the Rio Sesame. Both varieties yield more when planted early but there is no significant interaction between variety and spacing.

An interesting fact is that the yield of Local Sesame planted on 5/3/57 on the Nkumba black loams, is twice as much as the yield of Local Sesame planted on 6/3/57 on the red sandy loams.

Small samples of varieties from Venezuela were grown. No accurate estimate of yield could be obtained this year, but the varieties look extremely promising. They are Venezuela 51, Venezuela 52, Morada, Acarigua and Inamar. Venezuela 51 and Acarigua are unbranched. Morada, Venezuela 52 and Inamar are branched, Inamar rather less than the other two. All have three capsules per node, in contrast to the local African Sesame which has one capsule per node. Morada, which has purple leaves and stem, is less attacked by *Cercospora* and *Alternaria* than the others. Morada grown under irrigation at Beta during the dry season showed a resistance to aphid attack.

At Nachingwea, Acarigua, Venezuela 51 and Inamar take about 100 days to mature, Venezuela 52 103 days, and Morada 128 days. They are remarkably uniform in maturity, which will be a great asset for harvesting. This is in contrast to the Local Sesame grown at present, individual plants of which mature from 117 to 131 days.

Selection.

Selections from both the Local Sesame and the Venezuela varieties were made. Venezuela 51, and Venezuela 52 seem very uniform as far as yield is concerned, but the other Venezuela varieties seemed to be a mixture of types.

A search for individual plants of local sesame bearing three capsules per node was made, in the district and within bulks on the experimental farm. One plant with a tendency to bear either two or three capsules per node was found. This may prove useful in the breeding programme.

Breeding.

The breeding programme, ultimately, will be to produce a non-shattering high yielding variety suitable for Nachingwea conditions, but it is probable that the non-shattering character will not be easy to transfer. Initially high yielding shattering types will be produced, both unbranched and branched. The following crosses were made during the dry season, with these aims in mind:—

Rio × Morada.
Rio × Acarigua.
Rio × Inamar.
Rio × Local Sesame.
Rio × Venezuela 51.
Rio × Palmetto.
Palmetto × Venezuela 51.
Palmetto × Morada.
Palmetto × Local Sesame.
Palmetto × Acarigua.
Local Sesame × Venezuela 51.
Local Sesame × Acarigua.
Local Sesame × Inamar.
Local Sesame × Morada.
Morada × Acarigua.
Morada × Venezuela 51.
Morada × Inamar.
Inamar × Acarigua.
Inamar × Venezuela 51.

D.—Sorghum

1.—Breeding.

(a) *Swaziland P 41 x "U.K." strains from Ukiriguru.*—The object of this cross was to obtain a high yielding, white seeded variety suitable for combine harvesting. Twenty-three lines (F 6 generation) selected from this cross were grown this season in a trial with Swaziland P 41 and Combine Kaffir. Table IX gives an extract from the results.

TABLE IX.—SORGHUM STRAIN TRIAL BALANCED LATTICE 5 × 5

Yield in Lb. per Acre

Strain		Yield
Swaziland P41 × "U.K."	Strain ... 1 ...	1,478
	Strain ... 2 ...	1,526
	Strain ... 4 ...	1,727
	Strain ... 5 ...	1,806
	Strain ... 6 ...	2,049
	Strain ... 7 ...	1,735
	Strain ... 11 ...	1,185
	Strain ... 12 ...	1,815
	Strain ... 19 ...	2,047
	Strain ... 22 ...	1,705
	Strain ... 23 ...	2,147
Swaziland P41	... ...	1,664
Combine Kaffir	... ...	967
Significant Difference 5 per cent ...	... ...	366
1 per cent ...	... ...	485

Two of these strains are being retained. Their characteristics are:—

Strain 23:—Short straw, early maturing and suitable for combine harvesting. The head is of the open type with good exertion. The grain is pure white externally with a dark nucellar layer internally.

Strain 6:—Similar to Strain 23, but the grain is off-white in colour and the head is more closed.

These strains are superior to Swaziland P 41 and Combine Kaffir with regard to uniformity, height, strength of straw and yield, but like these varieties they have a non-cornaceous grain.

2.—Selection.

One hundred and thirty-two selections from a bulk population of the backcross BC 2MS ex Ukiriguru were made. This material resulted from a cross between BC 27 (a variety from the Congo which is small, short season and poor grained) and Msumbiji (the most popular African Sorghum in the Southern Province, which is tall, long season and has good grain). This cross was then back crossed to BC 27. Some very good material seems to be coming from this cross. The requirements are a group of varieties of differing maturity lengths, but all with good grain quality, high yield and short straw.

E.—Sunflower

The object of work with this crop, is to produce improved strains of the variety "West Nile". The chief aims are:—

(a) The selection of strains with a high degree of self fertility.
(b) The elimination of all seed colours other than white.
(c) The selection of strains of uniform height.
(d) The elimination of multiheaded plants.
(e) Improvement on the yield of the present unselected material.

Synthetics I and II were produced in 1956 from the first and second generations of selfing respectively. They were put into trial this year with parental West Nile. Synthetic II had fewer multiheaded plants and it had white seed, but there was no significant difference in yield between the Synthetics and the parental West Nile.

The third selfing generation (S 3) was grown in the dry season under irrigation, but although lines with no multiheads and uniform heights were obtained, the number of fertile seeds obtained was disappointingly low. Some lines were completely lost due to the lack of full seeds.

It was thought that the small amount of fertile seeds obtained may have been due to growing out of season, and thus in the wet season another S 3 generation was grown from seeds remaining from the S 2 generation. These, however, also gave a small amount of fertile seeds. This suggests that either loss of vigour has occurred, or that self fertility is not present in the variety West Nile.

A fourth generation of selfing was carried out, and some of the lines obtained were very uniform. There were still only a few fertile seeds being produced.

As the seeds obtained from both S 3 and S 4 generations are too few to test for combining ability in the normal way attempts will be made to form Synthetics next season by allowing lines selected by eye to be recombined by natural crossing in isolation.

F.—Cashew

Yields from individual trees in a plantation at Nachingwea have now been recorded for four years, but there seems to be no correlation in the yields during this time. Many of the trees suffer from waterlogging and it is not really an ideal site for recording the yields of trees. Another plantation will be chosen to begin recording of trees next year.

The nuts from each tree were graded into five groups of differing specific gravities, ranging from a specific gravity below 1,000 to one above 1,075. Some trees showed a high percentage of nuts with high specific gravity. It has been shown that high shelling percentage and kernel quality are correlated with high specific gravity of the whole nut.

High yielding trees are being recorded by the Agricultural Officers in the Province. Air layers were made on some of these trees in the Masasi District this year, but there was only a small degree of success.

Cashew varieties from Trinidad, Ceylon, India, Malaya, Mozambique and Zanzibar have been imported.

G.—Rice (Mahiwa)

(1) A 5 × 5 Balanced Lattice strain trial was laid down, to test selections and varieties from Mwabagole with the local Southern Province rices. Table X gives the yields of the varieties at a spacing of 9″ × 9″. The yields as a percentage of Lindi Safara are given, this being the most common rice grown in the Southern Province.

TABLE X.—RICE STRAIN TRIAL

Selection	Origin	Yield in lb./Acre	Yield as percentage of Lindi Safara
0/105	Afaa Mwanza	3,300	95
0/730	Afaa Mwanza	3,398	98
0/746	Afaa Mwanza	4,850	140
0/759	Afaa Mwanza	3,329	96
0/760	Afaa Mwanza	3,311	95
1/104	Afaa Mwanza	4,685	135
1/133	Afaa Mwanza	3,920	119
1/158	Afaa Mwanza	3,746	108
1/159	Afaa Mwanza	4,453	128
2/200	Afaa Mwanza	3,640	105
0/906	Afaa Milombero	3,785	109
1/166	Afaa Kilombero	3,727	107
1/196	Afaa Kilombero	3,698	106
2/214	Afaa Kilombero	3,640	105
2/217	Afaa Kilombero	3,659	105
2/229	Afaa Kilombero	3,194	92
2/257	Afaa Kilombero	3,436	99
0/606	Sindano	3,475	100
2/100	Demerara Creole	2,226	64
1/324	Introduction	3,688	106
1/146	Kahogo	3,127	90
	Kahogo ex Mahiwa	3,194	92
	Karawai ex Mahiwa	2,933	84
	Ngwindimba ex Rondo	823	24
	Lindi Safara	3,475	100

Significant Difference

P = 0·05 ... ... 561 lb.
P = 0·01 ... ... 745 lb.

The three selections from Afaa Mwanza, 0/746, 1/104 and 1/159, will be put into trial again next year, and if they once again give significantly higher yields than Lindi Safara, one of them will be issued for growing in the Southern Province where a high yielding, uniform variety is badly needed. These varieties have strong straw and a fairly good flavour.

(2) The last year of a five year rotation trial was completed. Table XI shows the treatments and yields of rice in 1957. The variety used was Lindi Safara.

TABLE XI.—RICE ROTATION TRIAL

	Rotations			
Year	A	B	C	D
1953	Kudzu... ...	Rice... ...	Cassia loppings followed by Rice	Rice with sweet potatoes in dry season.
1954	Kudzu... ...	Rice... ...	,,	,,
1955	Rice	Rice... ...	,,	,,
1956	Rice	Rice... ...	,,	,,
1957	Rice	Rice... ...	,,	,,

Treatment Means:
A 3,266 lb. per acre.
B 2,205 lb. per acre.
C 3,075 lb. per acre.
D 2,815 lb. per acre.

Significant Difference:
P = 0·05 ... ... 701 lb. per acre.
P = 0·01 ... ... 954 lb. per acre.

Three years of growing rice after two years of resting the land (i.e. growing Kudzu), gives a significantly higher yield in the fifth year than the continuous growing of rice.

It is obvious however, that economically it is more advantageous to grow five crops of rice than three crops of rice in spite of the slight lowering of yields. Cassia loppings applied each year before growing rice however, gives a significantly better result than the continuous growing of rice without any application of Cassia. It seems that probably the continuous growing of rice with the application of Cassia loppings, to help maintain fertility, would be the best means of getting the most from the land over a period of five years. If irrigation were possible sweet potatoes could be grown in the dry season.

A. K. AUCKLAND,
Botanist

REGIONAL RESEARCH CENTRE, NACHINGWEA—ENTOMOLOGY

Work during the year has been concerned entirely with posts of Cashew, the emphasis being laid on the biology of the two Mirids *Helopeltis bergrothi* Reut. and *H. anacardii* Miller.

Towards the end of the year, however, a Curculionid borer was discovered, which is thought to be *Mecocorynus loripes* Ches., a species which is of considerable importance in Portuguese East Africa.

A study of the biology of this insect will be carried out during the coming year.

At the beginning of November, a tour was made of Handeni District, in Tanga Province, where cashew is a new venture. Some of the trees were coming into bearing for the first time and the nuts were being badly attacked by *Pseudotheraptus wayi*.

Seasonal Fluctuations in Helopeltis populations.

A distinct seasonal variation in population is found to occur with both species of *Helopeltis*. The maximum in 1957 occurred in July, numbers thereafter falling off steeply towards the end of the year.

A survey was carried out, weekly, in five fields all within the area farmed by the Tanganyika Agricultural Corporation. In each field, a block of a hundred trees was marked out, and five trees from each block selected for sampling.

The actual sampling consisted merely in collecting all visible adults and nymphs from the tree, a technique which does not of course give an estimate of the absolute numbers present, but should provide a rough guide to the trends from week to week.

The total numbers caught each week from the 25 trees are shown graphically in Figure IV.

It is hoped during the coming year to investigate the factors which lead to the fall off in numbers during the dry season.

Effect of Helopeltis on young trees.

It was thought that young trees would not be attacked by *Helopeltis* to any extent and a trial was laid down in 12 acres of young Cashew to determine at what age growth would begin to be affected.

The area was divided into two blocks of six acres, one half being dusted each week with a 1 per cent gamma B.H.C. dust applied at a rate of about ¾ lb./acre and the other left undusted. Nine blocks of nine trees were marked out in each half of the field and measurements made, once a month, of the height of the trees together with notes on the Helopeltis attack.

Dusting began at the beginning of May when the trees were already about two months old. By July it was clear that Helopeltis is capable of inflicting extremely heavy damage on first year trees. No trees on the undusted half of the field escaped damage of some sort, this ranging from severe leaf spotting to complete death of the tree. Many trees died back to ground level but recovered by sending up suckers.

Damage to dusted trees was very slight and confined to leaf spotting.

The measurements of height are shown graphically in Figure V.

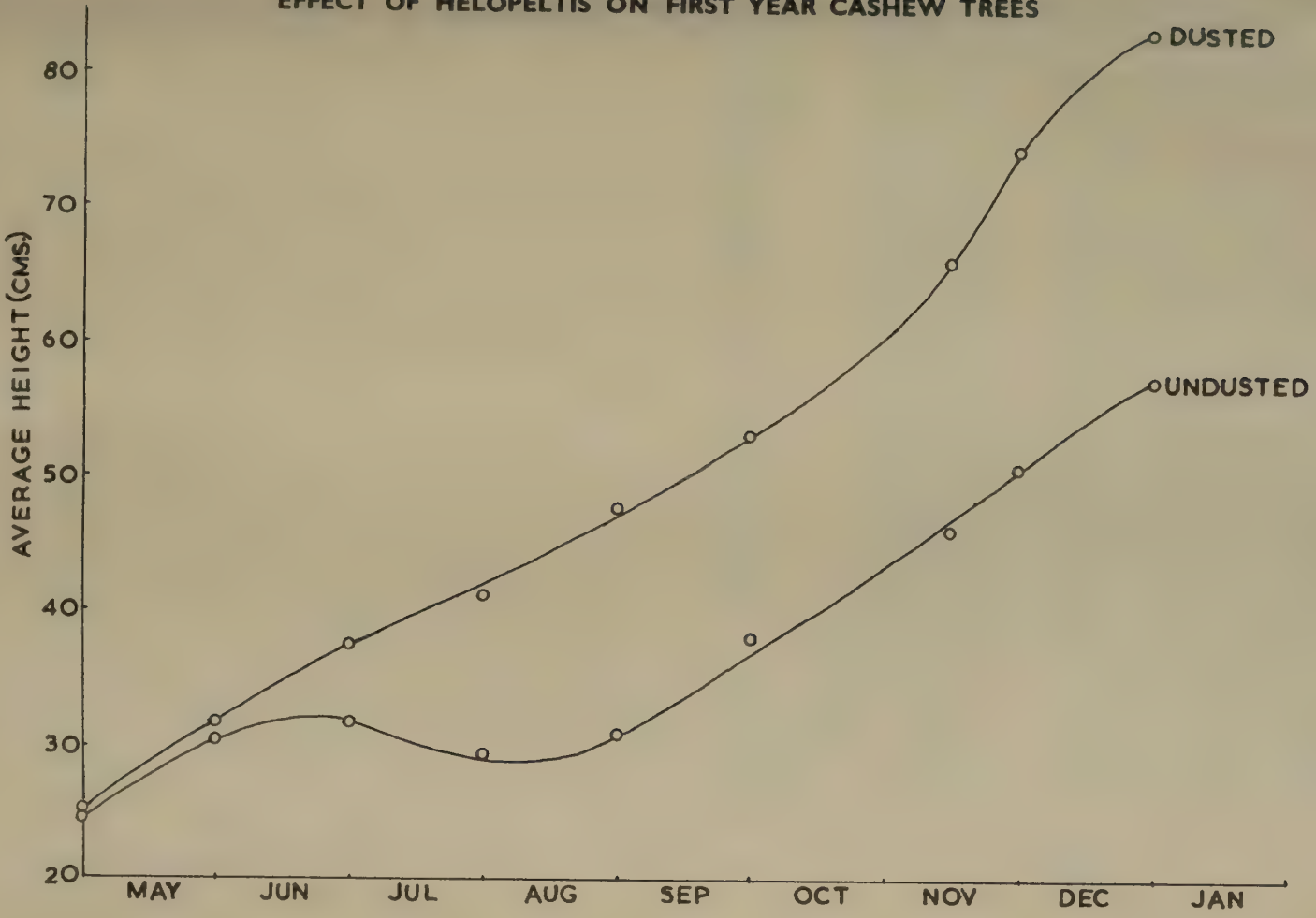
It will be seen that the effect of *Helopeltis* on growth was considerable, the reduction in August for undusted trees being brought about by severe dieback of the leading shoots. It is interesting to note that these trees do not show an increase in rate of growth with the beginning of the rains, which is a marked feature of the growth curve of the dusted trees.

FIGURE IV

HELOPELTIS POPULATION SURVEY

FIGURE V

EFFECT OF HELOPELTIS ON FIRST YEAR CASHEW TREES



Cashew Borer.

As mentioned previously, a new borer of Cashew was reported from Newala District at the end of November. There seems little doubt that it is *Mecocorynus loripes* Ches. but a positive identification has not yet been made. As far as is known, the insect is confined to the southeast corner of the Province in Newala, Mtwara and part of Lindi Districts.

The larva, which grows to 1¼ inches long, bores just beneath the bark, usually below a fork. Externally affected trees can be distinguished by the masses of black gum and frass which run down the trunk and collect on the ground below. When about to pupate, the larvae bore into the wood, filling the emergence hole with shavings.

On one tree, 45 larvae were removed from a wound some two feet across where the bark had been completely destroyed.

From observations of specimens kept in the laboratory, it would appear that the time taken to develop from egg to adult must be in the region of 100-120 days.

Other pests of Cashew.

Two further pests of little importance have been recorded from Cashew.

One is *Tupalus fasciatus* Dall. (Corcidae) which appears on the trees soon after the main crop has been removed and feeds on the nuts, producing a black spot reminiscent of *Pseudotheraptus wayi*, the other being a Bostrichid borer, *Apate terebrans* Pall. which appeared in several isolated places in the Nachingwea area but was not serious.

M. Bigger,
Entomologist

Acknowledgments.

The assistance of the Commonwealth Institute of Entomology in the identification of insects is gratefully acknowledged.

Advisory Services.

One hundred and sixty-five specimens were received for examination. The following new records for the territory were noted:—

Cowpea: Zonate leaf spot—*Ascochyta phaseolorum* Sacc.

Cucumber: Gummy stem blight—*Mycosphaerella melonis* (Pass) Chiu & Walker.

Eucalyptus maidenii F.V.M.: Stem blight—*Botrytis cinerea* Pers. ex Fr.

Groundnut: Stem canker and leaf blight—*Botrytis cinerea* Pers. ex Fr.

Wilt: *Fusarium oxysporum* Schl.

Lupin: Anthracnose—*Glomerella cingulata* Stonem, Spauld & V. Schrenk.

Maize: Leaf spot—*Phyllosticta zeae* Stout.

Onion: Basal Stem rot—*Fusarium oxysporum* Schl.

Pea: *Mycosphaerella* blight—*Mycosphaerella pinodes* (Berk & Blox) Stone.

Soy-bean: Anthracnose—*Glomerella glycines* Lehmann & Wolf.

Tobacco: Anthracnose—*Colletotrichum tabacum* Böning.

Investigational Work and disease situation in the territory:

Banana.—No change has occurred in the wilt (*Fusarium cubense*) situation during the year.

A nematode (*Pratylenchus* sp.) was found to cause a wilt in bananas similar to that associated with Panama disease.

Beans.—Severe outbreaks of Anthracnose (*Colletotrichum lindemuthianum*) were recorded in the Mbozi area of Southern Highlands Province during March. The source of infection was thought to be infected seed but samples examined showed no evidence of infection and it seems likely that peasant-grown beans provided the source of infection. Later plantings so that beans mature after the heavy rains would seem desirable if this and other diseases are to be avoided.

"Oily-pod", a condition of unknown origin, appeared once again in the Northern Province in May/June. The disease was apparently confined to variety No. 62. Symptoms are similar to those recorded for calcium deficiency but in analyses made by the Government Chemist, this was not borne out. Affected beans do, however, appear to be low in copper and experiments are at present in progress using copper chelate sprays to determine whether the condition is due to copper deficiency. Most of the work in this condition has been carried out by Mr. E. C. Hislop of the Colonial Pesticides Research Unit and his help is gratefully acknowledged.

The year was a bad one for beans and as a result of the heavy rains rust (*Uromyces appendiculatus*) was particularly devastating.

Citrus.—Young citrus in the nurseries of the Sisal Research Station were found to be infected with Gummosis (*Phytophthora* probably *parasitica* Dast). This disease had been previously ascribed to *Fusarium solani* but it now appears that this is a secondary organism.

Coffee. Stem-pitting.—This condition reported for the first time last year has now been recorded in all the principal coffee-growing areas. The effects of the pitting have been variable and in only a small number of cases have there been deaths or die-back. Limited work was carried out on this condition during the year to try and determine the cause: this may be summed up as follows: sap-inoculations to healthy seedlings have produced no stem-pitting. Dodder was investigated as a transmission agent but failed to "take". Paper chromatography of affected sap and sap from unaffected trees did not show any differences in amino-acid content which might lend support to a virus cause. Grafts of affected scions to healthy stocks have not grown sufficiently as yet to show stem-pitting. The stem-pitting condition is shortly to be investigated by a virologist.

Leaf Rust (*Hemileia vastatrix* Berk and Br.) has been severe in most localities in the past year, in some cases causing complete defoliation. Greenhouse trials with a large range of fungicides have been continued. Preliminary results show that mercury fungicides are more active than copper or organics but the trials have not so far stood the test of field conditions. Records of rust intensity throughout the year were taken at Lyamungu. The disease shows a well-defined periodicity and the actual number of sori present is at its lowest between the Short and Long Rains. The possibility of using eradicant fungicides at this time to reduce inoculum to a very low level before the Long Rains is under investigation. Trials have been started using copper/oil in oil fungicides which have proved very satisfactory as fungistatics within leaf tissue with other pathogen/host complexes. A field trial using air-blast equipment to compare the organic fungicides Zineb and Thiram with copper have shown that these are somewhat inferior to copper as protective sprays.

Nematodes (*Meloidegyne* sp.) sometimes cause damage in coffee particularly in the Lushoto area. Trials with Shell Nemagon, a soil fumigant which can be applied to growing plants, have shown that the fumigant will reduce the nematode population in the top foot of soil but that the reduction is not so great at 2 feet level. No differences were recorded in the growth rates of treated and untreated coffee. The experiment is sited at Lyamungu and observations are continuing.

The bark disease fungus (*Fusarium lateritium* Nees var. *Longum* Wr.) was found to be responsible for the die-back of "leaders" in a large number of trees in a trial at Lyamungu. It appears that the fungus gained entry through pruning cuts and leaf scars probably during a very wet period. This is an unusual manifestation of this disease.

Investigations were completed on the suspected DDT damage in coffee at Masama. It now seems likely that the DDT was either contaminated with a hormone weed-killer or that the emulsion had broken down releasing products which caused leaf distortion.

Cotton.—Violent leaf distortion and vein thickening reminiscent of a virus infection were noted in cotton growing at Arusha Chini Sugar Estate. This was attributed to spray drift and contamination of irrigation water by 2:4:D used for spraying weeds in the sugar cane.

Groundnuts.—Root rot (*Sclerotium rolfsii* Sacc.) caused heavy losses of groundnuts in the Arusha area. The damage followed a particularly wet period and the groundnuts were water-logged for a considerable time.

Fusarium oxysporum Schl. was isolated from wilted groundnuts from Handeni and Lupa Tinga Tinga. This is not a recorded pathogen of groundnut but causes wilt diseases in other crops. Inoculations are in progress to determine the pathogenicity of this organism for groundnuts. A stem and leaf disease of groundnuts was found to be due to *Botrytis cinerea* Pers. ex Fr. *Botrytis* diseases are somewhat uncommon in warm climates and it is inferred that the exceptionally wet, cool Long Rains season was responsible for the outbreak.

Grasses.—Brown patch (*Helminthosporium cynodentis* Marig. and *Corticium solani* (Prill. and Delacr.) Bourd. and Gals.) have been troublesome on golf courses turfed with *Cynodon dactylon* varieties, particularly in Dar es Salaam and Moshi. Effective control was obtained with compounds of mercury.

Lucerne.—Root rot (*Sclerotium rolfsii* Sacc.) caused heavy losses of lucerne at the Tanga Dairy Farm following waterlogging during heavy rains.

Lupin.—Anthracnose (*Glomerella cingulata* Stonem. Spauld and v. Schrenk) was widespread on lupins in the Porotos and Mbozi areas causing stem cankers and pod-spotting. It appears that the seed used for planting was infected.

Palm (Coconut).—Cases of suspected "Lethal Yellows" have occurred near Bagamoyo. This disease has caused severe losses in Jamaica. The disease has not been positively diagnosed in Tanganyika as yet but contact has been made with Dr. F. J. Nutman in Nairobi who is an authority on "Lethal Yellows" with a view to checking the diagnosis.

Peas.—*Mycosphaerella* blight (*Mycosphaerella pinodes* (Berk. and Blox) Stone) was responsible for the loss of experimental pea plantings at Mbozi. The disease was probably introduced on the seed as it has not been recorded in the Territory before.

Potato.—Bacterial wilt (*Pseudomonas solanacearum* (E.F.Sm.) Dowson) occurred in blight-resistant potatoes being bulked for seed at Lushoto and at several African shambas in the Lushoto District. The outbreak at the Magamba plot (Lushoto) seriously interfered with seed-bulking and it has been necessary to select new sites for seed multiplication.

Pyrethrum.—New plantings in the Vunjo/Rombo division of Kilimanjaro have been dying-off. The cause of this trouble has not been determined. The plants do not seem to have suffered fungal or bacterial invasion but some plants were found to harbour leaf eelworms which may have some significance. The trouble is still under investigation.

Sisal.—A bole rot associated with *Botryodiplodia theobromae* Pat. caused the loss of a number of *Agave* hybrids at the Sisal Research Station. As the fungus is a weak parasite, it was concluded that it gained entry into the plants through wounds made during the collection of basal suckers.

Tobacco.—Anthracnose (*Colletotrichum tabacum*) Böning was recorded for the first time in Tanganyika in December causing severe losses at Urambo and Lupa Tinga Tinga. This disease has been responsible for considerable damage in the Rhodesias over the past few years and it is not controlled by copper fungicides. "Zineb" fungicides have given excellent control and though all farms have been affected in the areas in question and there is a serious shortage of seedlings, the situation is improving steadily.

E. A. Riley,
Plant Pathologist

LYAMUNGU, ENTOMOLOGY

Coffee Leaf-Miner. Leaf-Miner (*Leucoptera coffeella* and to a lesser extent *L. caffeina*) has been of increasing importance to coffee farmers in recent years. In the past leaf-miners could be expected to appear during the hot season and to disappear well before the onset of the rains. Now the pest is becoming increasingly evident all the year round and in some cases is at a peak during the rains. The parasite complex seems to have changed also. The parasites described by Notley as being the most important have become almost scarce and another species, *Ageniaspis*, now seems to be the only parasite of importance.

The possibility of introducing new parasites as a means of control has been considered. The prospects of obtaining such control in the near future are not encouraging, and consequently a programme to investigate chemical control was drawn up.

Chemical Control of Leaf-Miner (*Leucoptera coffeella*).—Five organo-phosphorus insecticides (chlorothion, diazinon, malathion, metasystox and parathion) were screened against leaf-miner larvae actually mining in leaf tissue. Only diazinon and parathion were found to be effective at low doses. A chlorinated compound, dieldrin, was found to be ineffective, and promising results from the previous years' work were not confirmed.

Working on mixed miner populations (i.e. all instars present) and examining only those visible to the naked eye it was concluded that 1¼ pints of diazinon 60 per cent E.C. per 100 gallons and 2 lb. of parathion 20 per cent wettable powder gave a 95 per cent kill under field conditions.

First instar larvae were much easier to kill and it is thought (not proved experimentally) that less than half of the above doses would effect a very satisfactory control. None of the insecticides gave any indication of affecting unhatched eggs or pupae.

On a field scale, spraying with parathion or diazinon gave variable results. In one estate two to three months after spraying and achieving a good mortality, the populations rose steeply until the new infestation was far higher than the original. Larval populations were mixed (i.e. all larval instars were present) and there was little sign of parasite activity. On another estate one spraying gave a good control, but there was no rise in population two generations after treatment. Leaf-miner was almost eliminated by natural factors, mainly, it is thought, by the parasite *Ageniaspis* sp. In other farms the results were intermediate between these two extreme cases.

No efforts have been made to control moths.

Long term experiment to determine the economic importance of Leaf-Miner.—About two and a half acres of coffee were planted during the year to determine the effect of leaf-miner and leaf-rust, together and separately, on crop yields under three sets of conditions, viz: no shade, banana shade, and banana and tree shade.

In other short term guiding experiments where spraying treatments were imposed on guard rows of other trials a significant increase in crop was obtained. One trial yielded at the rate of 11·6 cwt. clean coffee/acre in control and 14·9 cwt. clean coffee/acre in treated (Standard error 1·4 cwt.). A second gave 8·8 cwt. coffee/acre in control and 13 cwt./acre in treated (Standard error 0·6 cwt.). It was found later that the increase in crop was largely (but not entirely in the latter case) due to berry-moth being eliminated in treated plots. Nevertheless, trees which carried the heavier crop looked neither better nor worse at the end of the season than the trees which carried the lighter crop, so it may be that the extra leaf retention achieved by leaf-miner control compensated for the higher yields. In the second experiment about two extra cwt./acre could not be attributed to berry-moth control.

Leaf-Miner and Hemileia Survey.—A survey was begun in October after the basic work on sampling had been completed. Leaf counts, noting the incidence of miners, leaf-rust and leaf-fall, are being made at regular monthly intervals over a wide altitude range on S. Kilimanjaro, to determine exactly what happens to coffee leaf during the different seasons.

From the data obtained it is hoped to assess the importance of miners and rust under a wide range of conditions, to obtain facts on seasonal incidence as a guide for any future spray programmes, and to correlate the incidence of miners and rust with yields and ecological conditions.

The survey is being extended to estates in other areas where any special treatments are being imposed.

Coffee Thrips (*Diarthrothrips coffeae*).—Because of the devastation at Oldeani caused by the common coffee thrips which showed signs of DDT resistance in 1956/57, a small field laboratory was set up to study thrips on the spot. Particular points to be studied include: the optimum dose of insecticides to effect control, the biological persistence of insecticides, and most important of all, to obtain dosage-mortality graphs (recording susceptibility of thrips to insecticides) so that future insecticide resistance may be detected before any harm be done.

Unfortunately (for the work) the weather never allowed thrips populations to exert any pressure and there was no extensive outbreak. A measure of the dose of dieldrin required to effect control in a few miner outbreaks was obtained. On Kilimanjaro a few outbreaks of thrips were found and three cases were investigated. Unusually heavy rains checked the outbreaks just as they were developing well for experimentation. Of three cases investigated one case of apparent resistance to DDT was noted. All were sensitive to low doses of dieldrin.

Stephanoderes (*Hypothenemus hampei*).—Results reported from Bukoba in the 1956 season (see Annual Report for 1956) were confirmed in full during 1957. The experiment was extended to the second phase of research where two whole villages were treated, mainly to note whether other important (but at present dormant) pests were affected by the insecticide. In particular outbreaks of the Kenya coffee mealybug and lacewing bugs are feared.

Pest assessment trials using single tree plots failed because of the rapid reinfection by the beetles from surrounding untreated trees.

Berry-Moth (*Thliptoceras octaguttallis*).—Berry-moth in some areas is now of major importance and many farmers have complained of serious loss of crop. At Lyamungu the loss of crop due to the moth (see above) was surprising, and it seems that a loss of 2 to 3 cwt. of clean coffee per acre passes almost unnoticed.

A small experiment was started to find a method of estimating crop losses due to berry borer. Two branches from each of 30 trees were selected. One branch on each was treated to prevent borer damage and the other branch was left untreated. The treated branches carried a total of 706 coffee bearing nodes with an average of 10·9 cherries per node, and the untreated branches carried 772 bearing nodes, of which 301 were damaged by berry-moth and had an average of 7·3 cherries per node. As was expected the loss of crop on the untreated branches was directly proportional to the number of damaged nodes. The remaining cherries on the untreated branches did not increase in weight to compensate for the loss in number. The experiment was not entirely satisfactory as the trees on which the tests were made suffered severe dieback at the end of the season.

One estate at Arusha and one at Usa appeared to obtain very satisfactory results in berry-moth control by spraying immediately after flowering. Other instances of spraying some weeks after flowering have given variable, and not very good, results.

Insecticide Dosages and Persistence.—In association with the Colonial Pesticides Research Unit a study of the chemical and biological persistence of chlorinated insecticides under field conditions was carried out. It was found that DDT, dieldrin and endrin were by no means as persistent in the field as was expected. The insecticide concentration diminishes rapidly during the first few days and then tails off slowly. Wettable powder deposits are lost more rapidly than emulsions. Using field collected Antestia as a test insect it was found that 100 per cent mortality could be expected only if the insects were on the trees before or immediately after spraying. Afterwards the killing power declines very sharply. Certainly

after the first day the kill is not economic. While after a few days very few Antestia are killed by the insecticide it is not yet known how the deposit affects smaller insects, particularly the parasites associated with coffee pests.

Together with the field work similar tests are being made with potted plants. By the end of the year a laboratory sprayer which had been built was found by the Physics Section of Colonial Pesticides Research Unit to give reasonably consistent and reproduceable results. Some dosage/mortality lines of several chlorinated compounds have been obtained for Antestia.

Alternative Insecticides for Antestia (*Antestiopsis lincaticollis*) *Control.*—All tests reported here were made with a tractor-drawn air-blast sprayer applying 80 gallons of spray per acre.

The question arose during the year as to whether Antestia could be more economically killed by using other insecticides. This raised the question of whether the optimum amount of DDT was being used.

It is still too early to arrive at definite conclusions but tentative conclusions drawn from 9 tests with DDT, 12 tests with dieldrin, 8 tests with endrin suggest that twice as much DDT has been used in the past as is really necessary, that ½-1 pint of dieldrin 18 per cent emulsifiable concentrate per acre is necessary to kill Antestia, and the endrin 19·5 E.C. at ¼ and ½ pint per acre is insufficient to effect a control (in spite of initial results to the contrary).

In exceptionally tall and bushy trees poor Antestia kills were obtained with both high dosages of dieldrin (2 pints/acre) and usual dosages of DDT.

Tests carried out independently of this laboratory, but kept under observation, showed that ¾–1 pint of dieldrin 18 per cent E.C. per acre achieved a good control using only 8 gallons of spray per acre.

Perhaps surprisingly, the results obtained in the laboratory using DDT and dieldrin were very similar to those obtained in the field.

Some tests (two on the Station and one independent) carried out with malathion as recommended by the Coffee Research Station, Kenya, indicate that malathion does not give consistently good results.

White Coffee Borer (*Anthores leuconotus, Pase.*) *Control.*—A final examination of experimental results from coffee treated with a ½ per cent dieldrin emulsion during the last months of 1954 revealed that in four shaded plots the insecticide was still effective against ring-barking larvae. The remaining 24 plots had either been re-treated by the farmer or, in some cases, uprooted.

Many dead larvae or incomplete burrows were observed in the treated plots. Many living larvae were found above the "treated zone" in both control and treated plots.

Sample discs of bark were taken from trees sprayed in 1954 and the Chemist of the Colonial Pesticides Research Unit, Arusha, found 9 mgm./sq. ft. of dieldrin still persisting. (Compare this figure with 2 to 3 mgm. per sq. ft. of foliage when spraying against Antestia).

It is believed that the initial dose of dieldrin was about 300 mgm./sq. ft. and it is thought that about 50 per cent of this was lost after six months' exposure in the field. The residual dieldrin seems to disappear more slowly. The 9 mgm. or 3½ per cent is the quantity left after 2¼ years.

Dieldrin lacquers as described previously have failed at this stage in all plots examined. This is considered to be due to the lacquer flaking off the tree rather than insecticide loss.

Aracina.—An eriophyid of apparently a new genus, but related to *Rhynacus* Kiefer, was found on the underside of coffee leaves over a wide area in the Northern Province. Several hundred mites were sometimes to be found on one leaf, but no appreciable damage to the leaf tissue was observed. The mites damage small patches of epidermis, but not underlying tissue. All expected stages in the life cycle were observed to be free on the leaf surface.

Brevipalpus phoenicis (Geijskes) was found in large numbers in several areas in the Northern Province and is thought to damage coffee cherry and prevent normal ripening, the green cherry becoming brown instead of bright red.

In the laboratory the Plant Pathologist noted incidentally in a fungicide screening trial that all potted plants treated with copper oxide or copper oxychloride suspensions were heavily infested with *B. phoenicis*. Those treated with colloidal coppers (including Bordeaux) and other fungicides, and the control plants, were free of the mite. The various treatments were all placed at random in the test room and all had an equal chance of being infested. It seems possible, therefore, that the increased mite activity observed in the field may be due in part to the increasing use of ready formulated copper fungicides which are replacing the farm-formulated Bordeaux mixture.

R. G. Tapley,
Entomologist

REGIONAL RESEARCH CENTRE, TENGERU—ENTOMOLOGY

Rainfall In Inches

Month	Total	Average for previous 8 years
January	5·72	... 2·65
February...	2·08	... 2·48
March	3·28	... 3·21
April	14·94	... 12·77
May	10·74	... 6·03
June	0·41	... 0·69
July	0·73	... 0·62
August	0·30	... 0·46
September	0·67	... 0·57
October	2·01	... 1·48
November	8·55	... 2·78
December	4·07	... 3·64
...	53·50	... 37·38

Both long and short rains were above average. Rainfall in November was the highest recorded for the past eight years.

Entomological work at Tengeru has been concerned largely with a survey of the insect pests of castor. Damage to the buds and developing fruits is caused by a number of Mirid bugs (of which *Lygus vosseleri*, Popp. is generally the most important), Pentatomid bugs, (*Acrosternum pallidoconspersa* Stal., *Calidea bohemani* St., *Nezara viridula* L. and *Cryptacrus comes* Fabr. var. *rufopictus* Walk.) and the Tortricid larva *Argyroploce leucotreta* Mery. Leaf damage is caused by Mirid bugs and young stages of the Pentatomid bugs and by larvae of *Euproctis rubricosts* Fawcett and *Heliothis armigera* Hbn. Severe stem boring by the Cossid larvae *Xyleutes capensis* Walk. has been recorded in the giant native castors only. The grasshopper, *Zonocerus elegans* Thnbg. is a general feeder on giant castors towards the end of the season.

Preliminary observations were made of the insects damaging buds and developing fruits in the Morogoro District. The degree of insect damage caused to developing fruits of giant type castors in Morogoro is shown in Table I. It is clear that sucking bugs are more important than Lepidopterous pests. The recently introduced dwarf varieties of castor are much more susceptible than the giant native varieties and where sucking bug damage is severe it may be essential to protect these dwarf varieties with insecticide.

TABLE I

Examination of Seeds in Developing Castor Fruits, Morogoro, July and August, 1957

Locality	No. of fruits	Fallen fruits or fruits easily removed by shaking spike			Fruits removed only by pulling from spike		
		Seeds damaged by sucking bug %	Seeds damaged by larvae %	Seeds not damaged %	Seeds damaged by sucking bug %	Seeds damaged by larvae %	Seeds not damaged %
A. African shambas	50...	66	22	12	0	0	100
B. Morogoro farm	50 medium size	82	4	14	10	0	90
C. Morogoro farm	50 almost mature fruits...	98	2	0	8	2	90

The effect of bagging individuals of *Acrosternum* and *Lygus* on developing buds and fruiting spikes is shown in Table II. Any insects present on the buds or spikes were first killed by spraying with a pyrethrum aerosol.

TABLE II

THE EFFECT OF ACROSTERNUM AND LYGUS ON DEVELOPING CASTOR BUDS AND FRUIT—MOROGORO, JULY, 1957

Bag No.	Stage of plant bagged	Insects inserted	Subsequent examination
1	Unopened bud	3 Acrosternum nymphs ...	7 days after bagging. Bud blackened and dead.
2	Fruit spike with small fruit ...	4 Acrosternum nymphs ...	42 days after bagging. No fruits on spike. 54 fallen fruits, seeds sucked.
3	Unopened bud, and fruit spike with medium-sized fruits ...	712 Lygus adults	20 days after bagging, bud dead. 34 days after bagging, poor set of fruit on spike. 8 fallen fruits, seeds sucked.
4	Fruit spike with small fruit ...	6 Lygus nymphs	17 days after bagging. 15 fallen fruits, seed sucked. 8 fruits remaining on spike.
5	Clean buds. One slightly open, one just forming ...	Control—no insects	33 days after bagging. 60 fruits formed on the developing spike. No fallen fruits. New bud undamaged.

The life-cycles of most of the sucking bugs found on castor, with the exception of *Lygus vosseleri* Popp, have not been previously investigated. Details of the life-cycle of *Acrosternum pallidoconspersa* Stal. obtained in the insectary at Morogoro are given in Table III.

TABLE III

THE LIFE-CYCLE OF ACROSTERNUM PALLIDOCONSPERSA STAL AT MOROGORO, AUGUST-SEPTEMBER, 1957

	Stage						
	Egg	Nymph					Total to adult
		1	2	3	4	5	
No. of observations	5	5	5	5	5	5	
Duration in days	10	5	8	6	7·8	13·0	49·8

Seasonal incidence of castor pests.

Large numbers of sucking bugs were observed in the period April to August in the Eastern Province on both the giant and dwarf varieties. The insects decreased considerably in numbers from September to early December when a slight increase was observed on the giant castors. Dwarf castor planted at Bwakira Chini on 26.3.57 was very heavily damaged when inspected on 18.7.57; plantings made on 8.5.57 showed damage to the first formed spikes on 18.7.57 but subsequently produced a good crop free of insect damage. In the Northern Province at Magara short-term castor planted on 20.7.57 and grown under irrigation was found heavily infested with *Acrosternum pallidoconspersa* Stal. and *Lygus vosseleri* Popp. on 28.11.57. A yield of approximately 700 lb. castor seed per acre was obtained but practically no crop was produced from spikes formed during and after November. Nearby dwarf castor planted on 30.11.57 had produced two or three spikes per plant by 8.1.58 and was free of sucking bugs, although these were still present on the earlier planting. From

these observations it would seem that the main infestations of sucking bug coincide with the main rains, that the numbers decrease with the onset of the dry season and that some increase may take place towards the end of the year.

Miscellaneous Records.

An unidentified Melolonthid larva was found in large numbers reducing stands of pyrethrum on a farm at North Meru. Soil applications of 0·5 per cent gamma BHC dust and 2·5 per cent aldrin dust have been made but so far no further information has been obtained on their effect.

Harvester termites have caused spectacular local damage to dwarf beans in the Magara farms north of Babati. Chillies in the same area have been damaged by unidentified Jassids and mites. At Sanya Juu adults and larvae of the Lagriid beetle, *Lagria villosa* F., severely damaged pawpaw seedlings in December but were rapidly killed by the application of an 0·1 per cent DDT emulsion spray.

Publications.

1. Swaine, G. (1957) Trials on the Underground Storage of Maize of High Moisture Content in Tanganyika. Bull. Ent. Res. 48. 397-407.

2. Swaine, G. The Maize and Sorghum Stalkborer, *Busseola fusca* in Peasant Agriculture in Tanganyika. To be published in Bull. Ent. Res.

G. Swaine,
Entomologist

REGIONAL RESEARCH CENTRE, TENGERU—PLANT BREEDING

Wheat.

The principal requirements of a wheat variety for Northern Province conditions are early maturity and resistance to rust.

A range of short-term selections and unfixed hybrid bulks, obtained from the plant breeding station at Njoro, and derived from various Australian × Kenya crosses, has been grown at Tengeru. The botanical and agronomic characters of the material have been studied.

Four varieties from Kenya have been distributed to farmers in the Ol Molog area for observation and seed multiplication. Three of these varieties, Lawrence, C.I. 12,632 and Rushmore selection, have been found to be resistant to stem rust, and may be useful "short rains" varieties.

Arrangements have been made to participate in the United States Department of Agriculture and F.A.O. rust and bunt testing programmes. Varieties received for testing may be a useful source of breeding material.

Maize.

The object of maize breeding work at Tengeru is the production of a high yielding and very early maturing variety. It is hoped to produce a white-grained maize with a growth period of 60-70 days.

Selection from local maize varieties, including Nyanza, Kenya White, Nachingwea Katumbili and Eksteen, have been made. Results to date with these selections have not been very promising.

Trials of imported material are also in progress. Unfortunately none of the varieties yet tested appear to have the extreme earliness that is desired. Additionally, many are yellow seeded. Some results of observations on white varieties are shown in Table I.

TABLE I

DAYS TO MATURITY: IMPORTED MAIZE VARIETIES.

Variety	Station and Rainfall during Season			
	Tengeru 27·19 inches	Ukiriguru 18·96 inches	Nachingwea 26·98 inches	Ilonga 34·87 inches
Venezuela 3	148	132	111	105
Rocol V. 101	149	135	116	105
Empal Izada	126	134	105	90
I. 451	139	116	—	110
Raton	127	113	102	105
Barretal	129	118	95	90
Taveron	103	113	92	90
White Kango	130	118	90	90

Yield figures are not available, as seed was very limited and it was only possible to plant small observation plots. Raton, Barretal and Taveron appeared to be the most promising varieties.

B. HOUSTON,
Botanist

GENERAL EXPERIMENTAL WORK, NORTHERN PROVINCE

A number of spacing experiments on maize were carried out in the Arusha District. Trial A below was at Essimingor, Trials B, C and D on various farms in the Oljoro area.

TABLE I

YIELDS OF MAIZE AT VARIOUS SPACINGS IN 3FT ROWS

(LB./ACRE)

Spacing in feet	A	B	C	D
½	—	3,511	—	2,341
1	3,616	2,977	3,129	3,232
1½	3,391	2,629	2,825	2,423
2	3,093	2,565	2,354	1,776
2½	3,083	2,169	2,032	1,759
3	2,866	2,089	1,681	—
4	2,742	—	1,537	—
Significant Difference 5 per cent	NS	530	266	604

A spacing of one foot between plants has given the best results.

In a pyrethrum experiment results to date suggest that the closer spacings are likely to give the highest yields.

Two varieties of groundnuts, Natal Common and Asiriya Mwitunde, were planted at a number of sites. Although the former is generally the higher yielder, A. Mwitunde was included because of the possibility of rosetted disease occurring. Both varieties yielded well but Natal Common was markedly superior at all sites.

Natal Common	1,472	lb. per acre.
Asiriya Mwitunde	766	lb. per acre.

In observation plots the yield of soya-bean varieties ranged from 245 to 1,059 lb. per acre. These two crops would appear to be promising for the area.

A. HAMERSLEY,

Acting Assistant Director of Agriculture

GENERAL EXPERIMENTAL WORK, TANGA PROVINCE

1.—Kunguli Farm (Lushoto District)

Potato Variety Observation Trial.—Five of the original 22 varieties, on which trials started five years ago, remained at the beginning of the year. Of these, varieties *1564a* (*14*) and *1673b* (*4*) have now been discarded, as both became infected with blight before the 1957 harvest.

Three varieties remain. *1521c* (*3*) continues to show blight resistance, but has now shown symptons of Bacterial wilt and Leaf Roll. As it has never been a popular eating potato it will be discarded. *1664a* (*12*) has remained blight resistant, and is of fairly high quality. It is being multiplied for seed supply. *1668a* (*2*) has remained resistant, is of excellent quality, and is being multiplied for distribution. Yields during the "Vuli" or short rains are generally as high as from the two preceding varieties. When planted in the "Masika" season (the long rains) it has given rather lower yields.

Sweet Potato Observation Trials.—A trial comparing 15 varieties was carried out for the sixth successive year. Yield differences were small, as in previous seasons. The trial will now be discontinued.

Vegetable Observation Trials.—Trials have been carried out to determine whether vegetables can be grown all the year round in the main Usambara area. At present there is generally a surplus from October to December, and a shortage from March to June. Plantings of the commoner types of vegetables have been made at monthly intervals at Kunguli, which is similar ecologically to the Usambara area. It appears that many types of vegetable can be grown satisfactorily at all seasons, although the planting date has a considerable influence on the number of days required for the crop to reach maturity.

Some types of vegetable—cucumber, garden peas, onions, spinach, broad beans, tomatoes, leeks, sweet peppers and blanching celery—appear to have more definite climatic requirements and will only grow satisfactorily when planted at certain times of the year.

Coffee Fertiliser Trial.—A trial investigating the effects of mulching and potash application has been laid down on young Arabica coffee. Analysis of Usambara soils, and leaf analysis of coffee in the area, has indicated a possible potassium deficiency. Although the coffee was damaged by Yellow Stalk Borer and Green Scale, there are indications that both mulching and potash treatments are having beneficial effects.

Trace Element Trial.—A trace element trial, involving applications of manganese, iron, zinc, copper and molybdenum compounds, together with macronutrients, was carried out on Saxa Beans. No treatment had a significant effect.

2.—District Trials (Lushoto District)

Wheat Observation Plots.—Yields from wheat variety observation plots at Sakarani in the Usambaras were as follows:—

Variety	Yield, lb./acre	Days to maturity
Regent	1,036 ...	210
W. 1	1,302 ...	196
R. 64	756 ...	210

Observation plots of permanent crops in high rainfall mountain areas, Korogwe.—Three observation plots, at altitudes of 2,000 feet, 2,500 feet and 3,200 feet were planted in 1957 with a variety of perennial cash crops. In this area the high rainfall almost precludes Arabica coffee growing, and an alternative cash crop, suitable for very steep slopes, is required.

Cocoa, cardamon, Robusta coffee, cinammon, cloves, ginger, sugar cane, and black pepper are under trial. No conclusions can yet be made from these observation plots, but in most cases establishment has been satisfactory. The cardamons have, however, suffered severely from drought and many have died. Conditions would appear to be unsuitable for this crop.

3.—Magoma Irrigation Plot

Trials of long staple cotton.—Observation trials of long staple cotton varieties have been carried out on reclaimed saline land, using furrow irrigation. The yields are shown in Table I.

TABLE I

Variety	Yield lb. seed cotton/acre	Remarks
L3/42	2,149	Nearly all Grade "A".
Wild Susc. 16/1	937	Nearly all Grade "A".
BAR 4/16...	826	All Grade "C".
R. 16	441	All Grade "C".
UK. 51 (short staple) ...	608	30 per cent Grade "C".

L. 3/42 would seem to be a promising variety for conditions at Magoma.

Groundnuts, vegetables and citrus have also grown well under irrigation. Maize has produced a rather poor yield.

4.—District Trials (Handeni District)

A Fertility Trial, started in 1951 to compare rotational cropping with continuous planting of the same crop, has now been discontinued. No significant yield differences have been recorded.

A comparison of contour ridging and flat cultivation has been carried out on about one hundred demonstration plots throughout eastern and central Handeni. Contour ridging has invariably produced the higher yield.

Except in the drier, marginal areas, "Katumbili" maize has given a higher yield than the local variety. "Enyanza" sorghum has outyielded the local type, "Gobo", in areas where the annual rainfall is above 30 inches. In drier districts "Gobo" has given higher yields.

5.—District Trials (Pare District)

A cotton variety × spacing × cultivation observation trial was carried out at Same. Yields from 2′ × 2′ spacing were higher than those from 2′ × 6″ or 2′ × 2′ 6″ on ridged land. With flat cultivation 2′ × 2′ 6″ ridging gave the highest yield. Ridged land produced a higher average yield than when the crop was grown without ridging.

Of the varieties tested, UK. 51 gave the highest yield. This is the variety at present being used by growers in Pare District.

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Provincial Agricultural Officer